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VOL. II. ANG——BAR

INDOCTI DISCANT, ET AMENT MEMINISSE PERITI.

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ENCYCLOPÆDIA.

ANGERMANIA, a province of the kingdom of Sweden, bounded on the N. by Lapland and Bothnia, on the E. by the gulph of Bothnia and Medelpadia, and on the W. by Jemti and Herndel. It is full of rocks, mountains, and forests; and there is one very high mountain called *Scull*. It has excellent iron-works, and lakes abounding with fish.

ANGERMOND, a town of the duchy of Berg, in Germany, on the E. side of the Rhine, subject to the elector Palatine. E. Long. 6. 20. N. Lat. 51. 10.

ANGERONA, in mythology, the name of a pagan deity whom the Romans prayed to for the cure of the *quinzy*: In Latin, *angina*. Pliny calls her the *goddess of silence* and *calmness of mind*, who banishes all uneasiness and melancholy. She is represented with her mouth covered, to denote patience and refraining from complaints. Her statue was set up, and sacrificed to, in the temple of the goddess Volupia, to show that a patient enduring of affliction leads to pleasure.

ANGERONALIA, in antiquity, solemn feasts held by the Romans the 21st of December, in honour of Angerona, or Angeronia, the goddess of patience and silence. Festus and Julius Modestus, quoted by Macrobius, Saturn. lib. i. cap. 10. derive the name from *angina*, "quinzy;" and suppose the goddess to have been thus denominated, because she presided over that disease.—Others suppose it formed from *angor*, "grief, pain;" to intimate that she gave relief to those afflicted therewith. Others deduce it from *angeo*, "I press, I close," as being reputed the goddess of silence, &c.

ANGERS, a great city of France, and capital of the duchy of Anjou, with a bishop's see. It is seated a little above the place where the Sarte and the Loire lose themselves in the Maine. This last river divides the city into two equal parts, called the high and the Low Town. There are twelve parishes in the city and four in the suburbs, which contain upwards of 36,000 inhabitants. Besides these, there are eight chapters, and a great number of convents for both sexes. Its greatest extent is along the declivity of a hill, which reaches quite down to the river side. The castle was built by St Louis, about the middle of the 13th centery. The walls, fosses, and numerous towers which yet subsist, evince its former magnificence; and its situation in the centre of the city, on a rock overhanging the river, conduces to give it an air of grandeur, though at present in decay. It was the principal residence of the kings of Sicily, as dukes of Anjou, but is now in a state of total ruin. The cathedral of Angers is a venerable structure; and although it has un-

dergone many alterations in the course of ages since its construction, yet the architecture is singular and deserves attention. Here lies interred with her ancestors the renowned Margaret, daughter of René king of Sicily, and queen of Henry VI. of England. She expired, after her many intrepid, but ineffectual, efforts to replace her husband on the throne, in the year 1482, at the castle of Dampierre in Anjou. Near the church of St Michael is the handsomest square in the city, from whence runs a street which has the name of the church. On one side of this street is the town-house; which has a fine tower, with a clock, raised upon an arch, which serves for a passage into the great square. There are two large bridges, which keep up a communication between the two parts of the city; and in the lesser of these there is another square, which serves for a market. The university of Angers was founded in 1398, and the academy of belles lettres in 1685. This last consists of thirty academicians. At the end of the suburbs of Bresigny are the quarries of Angiers, so famous for the fine slate which is got from thence. The pieces are of the thickness of a crown piece, and a foot square. All the houses in Angers are covered with this slate, which has gained it the appellation of the *Black City*. The walls with which king John of England surrounded it in 1214 remain nearly entire, and are of very great circumference. W. Long. 0. 30. N. Lat. 47. 28.

ANGHIERA, a town of Italy, in the duchy of Milan, and capital of a country of the same name. It is seated on the eastern side of the lake Maggiore, in E. Long. 9. 5. N. Lat. 45. 42.

ANGINA, in medicine, a violent inflammation of the throat, otherwise called *quinzy*. See Medicine-*Index*.

Angina Pectoris. See *Medicine-Index*.

ANGIOSPERMIA, in the Linnæan system of botany, the second order in the class Didynamia. It consists of those plants, of that class, whose seeds are inclosed in the pericarpium. In this order the stigma is generally obtuse. These are the *personati* of Tournefort.

ANGITIÆ lucus or Nemus (Virg.), situated on the west side of the Lacus Fucinus. The inhabitants are called *Lucenses*, by Pliny. Angitia was sister of Medea, who taught antidotes against poison and serpents, according to Sil. Italicus. But Servius on Virgil says, that the inhabitants called Medea by this name for the same reason. The town is now called *Luco*.

ANGLE, the inclination of two lines meeting one another in a point. See Geometry.

Angle ‖ Anglesey.

Angle of Incidence, in optics, the angle which a ray of light makes with a perpendicular to that point of the surface of any medium on which it falls: tho' it is sometimes understood of the angle which it makes with the surface itself.

Angle of Refraction, now generally means the angle which a ray of light, refracted by any medium, makes with a perpendicular to that point of the surface on which it was incident; but has sometimes been understood of the angle which it makes with the surface of the refracting medium itself.

ANGLER, a person who practises the art of angling, whether as a diversion, or otherwise. See the article ANGLING.

ANGLER, in ichthyology, the English name of a species of lophus. See LOPHUS.

ANGLES, an ancient German nation, originally a branch of the Suevi; who, after various migrations, settled in that part of Denmark, and duchy of Sleswick, which to this day is called *Angel*, and of which the city of Flensburgh is the capital. Here they were known, even in the time of Tacitus, by the name of *Angli*. The origin of this name is variously accounted for. According to Saxo-Grammaticus, they were called *Angli* from one Angulus, son to Humblus king of Denmark. Windischind, a Saxon writer, will have them to be called *Angli*, from an island in the corner or angle of the sea, which they conquered. Goropius derives their name from the Saxon word *Angel* or *Engel*, signifying a fish-hook; the Angles, like the other Saxon nations, being greatly addicted to piracy, and on that account being so named by the neighbouring nations; as if, like hooks, they caught all that was in the sea. To this nation the British ambassadors are said to have applied when soliciting succours against the Scots and Picts. The Angles therefore went over in greater numbers than any other Saxon nation; and accordingly had the honour of giving the name of *Anglia* to England. See ENGLAND.

ANGLESEY (Isle of,) is the most western country of North Wales. It is 24 miles in length, 18 in breadth, and sends one member to parliament. It is separated from Caernarvonshire by a strait called *Menai*, and on every other side is surrounded by the sea. It is a fertile spot, and abounds in corn, cattle, flesh, fish, and fowls.

At port Aethwy, the most general ferry into the island, there is a great passage of cattle. It is computed that the island sends forth annually from 12,000 to 15,000 heads, and multitudes of sheep and hogs. It is also computed that the remaining stock of cattle is 30,000. In 1770 upwards of 90,000 bushels of corn were exported, exclusive of wheat. The improvement in husbandry has greatly increased since the suppression of smuggling from the Isle of Man: before that time every farmer was mounted on some high promontory, expecting the vessel with illicit trade; but since that period, he has set in earnest to industry and cultivation. Not but that the island was in most remote time famous for its fertility: Mon, Mam Gymry, the Nursing-mother of Wales, was a title it assumed even in the 12th century.

This island is divided into 74 parishes, of which most of the churches are situated near the shores. By an account given on the 13th of August 1563, there were 2010 housholds, or families, in Anglesey; allowing five to a family, the whole number of inhabitants in that period was 10,050. It 1776, the number of houses in Anglesey was about 3,956: allowing five persons to a family, the whole number of inhabitants was at that time 19,780; which wants only 340 of doubling the number of inhabitants in the intervening space. The chief town is BEAUMARIS.

In ancient times this island was called *Mon*, *Mona*, or *Moneg*. It was the great nursery of the religion of the Druids; being the residence of the Grand Druid, or chief pontiff, and consequently of all the learned doctors in that religion.

Many ancient monuments of Druidism still remain in the island.—At Tre'r Dryw, or the habitation of the arch-druid, are several mutilated remains, which have been described by Mr Rowland. His *Bryn Gwyn*, or *Brein Gwyn*, or royal tribunal, is a circular hollow of 180 feet in diameter, surrounded by an immense agger of earth and stones, evidently brought from some other place, there not being any mark of their being taken from the spot. It has only a single entrance. This is supposed to have been the grand consistory of the druidical administration.—Not far from it was one of the *Gorseddau*, now in a manner dispersed, but which once consisted of a great copped heap of stones, on which sat aloft a druid, instructing the surrounding people *multa de Deorum immortalium vi et potestate disputare, et juventuti tradunt*; Cæs. lib. 6.—Here were also the relics of a circle of stones, with the *cromlech* in the midst; but all extremely imperfect. Two of the stones are very large; one, which serves at present as part of the end of a house, is 12 feet 7 inches high and 8 feet broad; and another 11 feet high and 23 feet in girth. Some lesser stones yet remain. The circle, when complete, was one of the temples of the druids, in which their religious rites were performed. It is the conjecture of Mr Rowland, that the whole of these remains were surrounded with a circle of oaks, and formed a deep and sacred grove: *Jam per se roborum elegunt lucos, neque ulla sacra sine ea fronde conficiunt*; (Plin. Hist. Nat. xv. 44.)—Near this is *Caer Leb*, or the moated entrenchment; of a square form, with a double rampart, and broad ditch intervening, and a lesser on the outside. Within are foundations of circular and of square buildings. This Mr Rowland supposes to have been the residence of the arch druid, and to have given the name, *Tre'r Dryw*, to the township in which it stands. At Trev-Wry are several faint traces of circles of stones, and other vestiges of buildings; but all so dilapidated, or hid in weeds, as to become almost formless. *Bod-drudan*, or the habitation of the druids, *Tre'r-Beirdd*, or that of the bard, and *Bodowyr*, or that of the priests, are all of them hamlets, nearly surrounding the seat of the chief druid, composing the essential part of his suite. At the last is a thick cromlech, resting on three stones.

The shore near Porthamel, not far from hence, is famed for being the place where Suetonius landed, and put an end in this island to the druid reign. His infantry passed over in flat-bottom boats, perhaps at the spot still called *Pant yr Yscraphie*, or the valley of *Skiffs*. His cavalry crossed partly by fording, partly by swimming. Of the conflict on this occasion we have the following animated description by Tacitus*:

* Annal. xiv. 30.

"Stat

Anglesey.

"Stat pro littore diversa acies, densa armis virisque, intercursantibus fæminis in modum furiarum, veste ferali, crinibus dejectis, faces preferebant; *druidæque* circum, preces diras sublatis ad cœlum manibus fundentes. Novitate aspectus percutere militem, ut quasi hærentibus membris, immobile corpus vulneribus præberent. Dein cohortionibus ducis, et se ipse stimulantes, ne muliebre et fanaticum agmen pavescerent, inferunt signa, sternuntque obvios et igni suo involvunt. Præsidium posthac impositum vicis, excisque luci, sævis superstitionibus sacri. Nam cruore captivo adolere aras, et hominum fibris consulere deos fas habebant."—Thus Englished: "On the shore stood a motley army in close array; and well armed; with women running wildly about in black attire with dishevelled hair, and like the furies brandishing their torches; surrounded by the druids, lifting up their hands to heaven, and pouring forth the most dreadful imprecations. The soldier stood astonished with the novelty of the sight. His limbs grew torpid, and his body remaining motionless resigned to every wound. At length, animated by their leader, and rousing one another not to be intimidated with a womanly and fanatic band, they displayed their ensigns, overthrew all who opposed them, and flung them into their own fires. After the battle, they placed garrisons in the towns, and cut down the groves consecrated to the most horrible superstitions: for the Britons held it right to sacrifice on their altars with the blood of their captives, and to consult the gods by the inspection of human entrails."—There are no traces of any Roman works left in this country. Their stay was so short, that they had not time to form any thing permanent.

Near the ferry of Moel y Don appear the fine woods of Sir Nicholas Bayley, skirting the Menni for a considerable way. The wooded part of the island is on this side. It commences at Llanidan, and recals the ancient British name of Anglesey, *Ynys Dywyll*, or the *Dark Island*, on account of the deep shade of its groves: but at present it is (except in this part) entirely divested of trees; and the climate so averse to their growth, that in most parts it is with great difficulty the gentry can raise a plantation round their houses. Plas Newydd, the seat of Sir Nicholas Bayley, lies close upon the water, protected on three sides by venerable oaks, and ashes. The view up and down this magnificent riverlike strait is extremely fine. The shores are rocky; those on the opposite side covered with woods; and beyond soar a long range of Snowdonian alps. Here stood a house built by Gwenllian, a descendent of Cadrod Hardd. The mansion has been improved, and altered to a castellated form by the present owner.

In the woods are some very remarkable druidical antiquities. Behind the house are to be seen two vast cromlechs. The upper stone of one is 12 feet 7 inches long, 12 broad, and four thick, supported by five tall stones. The other is but barely separated from the first: is almost a square of five feet and a half, and supported by four stones. The number of supporters to cromlechs are merely accidental, and depend on the size or form of the incumbent stone. These are the most magnificent in the island, and the highest from the ground; for a middle-sized horse may easily pass under the largest. In the lands of Llugwy, indeed, there is a most stupendous one of a rhomboidal form. The greatest diagonal is 17½ feet, the lesser 15, and the thickness three feet nine inches; but its height from the ground is only two feet: it is supported by several stones. The Welsh, who ascribe every thing stupendous to the famous king Arthur, call it *Arthur's Quoit*. In the woods at this place are some druidical circles nearly contiguous to each other.

At a small distance from Beaumaris, on the shore, stand the remains of Llanvaes, or the Friars. It was founded by Prince Llewelyn ap Jerwerth, and, according to the general tradition of the country, over the grave of his wife Joan, daughter of king John, who died in 1237, and was interred on the spot. Here also were interred a son of a Danish king, Lord Clifford, and many barons and knights who fell in the Welsh wars. It was dedicated to St Francis, and consecrated by Howel bishop of Bangor, a prelate who died in 1240. The religious were Franciscans, or minor friars. Their church and house were destroyed, and their lands wasted, in the insurrection made soon after the death of Llewelyn, last Welsh prince, by his relation Madoc. Edward II. in consideration of their misfortunes, remitted to them the payment of the taxes due to him, which before the war were levied at the rate of L.12, 10s. These friars were strong favourers of Glendwr. Henry, in his first march against Owen, plundered the convent, put several of the friars to the sword, and carried away the rest; but afterwards set them at liberty, made restitution to the place, but peopled it with English recluses. It possibly was again reduced to ruin; for Henry V. by patent, established here eight friars, but directed, that two only should be Welsh. At the dissolution, Henry VIII. sold the convent and its possessions to one of his courtiers. They became in later days the property of a family of the name of *White* (now extinct), who built here a good mansion. It of late became, by purchase, the property of Lord Bulkely. The church is turned into a barn, and the coffin of the princess Joan now serves for a watering-trough. A little farther is Castell Aber Llienawg, a small square fort, with the remains of a little round tower at each corner. In the middle one stood a square tower. A foss surrounds the whole. A hollow way is carried quite to the shore, and at its extremity is a large mound of earth, designed to cover the landing. This castle was founded by Hugh Lupus Earl of Chester, and Hugh the Red Earl of Shrewsbury, in 1098, when they made an invasion, and committed more savage barbarities on the poor natives, especially on one Kenred a priest, than ever stained the annals of any country. Providence sent Magnus king of Norway to revenge the cruelties. His coming was to all appearance casual. He offered to land, but was opposed by the earls. Magnus stood in the prow of his ship, and calling to him a most expert bowman, they at once directed their arrows at the Earl of Shrewsbury, who stood all armed on the shore. An arrow pierced his brain through one of his eyes, the only defenceless part. The victor, seeing him spring up in the agonies of death, insultingly cried out, in his own language, *Leit loupe*, "Let him dance." This fort was garrisoned so lately as the time of Charles I. when it was kept for the parliament by Sir Thomas Cheadle; but was taken by Colonel Robinson in 1645.

Above Llanddona is a high hill, called *Bwrdd Arthur*, Anglesey. thur, or Arthur's round table: the true name was probably *Din*, or *Dinas-Sulwy*; for a church immediately beneath bears that of *Llanvihangle Din-Sulwy*. On the top of it is a great British post, surrounded by a double row of rude stones with their sharp points uppermost; and in some parts the ramparts are formed of small stones. In the area are vestiges of oval buildings: the largest is formed with two rows of flat stones set on end. These had been the temporary habitations of the possessors. It had been a place of vast strength; for, besides the artificial defence, the hill slopes steeply on all sides, and the brink next to the ramparts is mostly precipitous. It is worth while to ascend this hill for the sake of the vast prospect; an intermixture of sea, rock, and alps, most savagely great.

About two miles south of Plas-Gwyn, the seat of Paul Panton, Esq; was situated Penmynnydd, once the residence of the ancestors of Owen Tudor, second husband to Catherine of France, queen dowager of Henry V.; "who beyng (as honest Halle informs us) young and lustye, folowyng more her owne appetyte than frendely consaill, and regardyng more her private affection than her open honour, toke to husband privily (in 1428) a goodly gentylman, and a beautiful person, garniged with manye godly gyftes both of nature and of grace, called *Owen Teuther*, a man brought furth and come of the noble lignage and auncient lyne of Cadwalader, the last kynge of the Britonnes." The match, important in its consequences, restored the British races of princes to the kingdom: These reigned long, under the title of the House of Tudor; the mixed race having ceased on the accession of Henry VII. grandson to our illustrious countryman. The remains of the residence of the Tudors are, the door of the gateway: part of the house, and the great chimney-piece of the hall, are to be seen in the present farm-house. Some coats of arms, and dates of the building or time of repairs, are to be seen, with the initial letters of the names of the owners. The Tudors, for a considerable space before the extinction of their race, assumed the name of *Owen*. Richard was the last male of the family, and was sheriff of the county in 1657. Margaret, heiress of the house, married Coningsby Williams, Esq; of Glan y gors, in this island, who possessed it during his life. It was afterwards sold to Lord Bulkley, in whose descendant it still continues. In the church of Penmynnydd is a most magnificent monument of white alabaster, removed at the dissolution from the abbey of Llanvaes to this place; probably erected in memory of one of the house of Tudor; who had been interred there. On it is the figure of a man in complete armour, a conic helm, and mail-guard down to his breast; his lady is in a thick angular hood; their feet rest on lions, and their heads are supported by angels.

On the western point of the bay is a small cape, flat at top, called *Castell-mawr*, joined to the land by a low isthmus. It is composed of lime-stone, which is carried to distant parts in small vessels, which lie in a small channel near the rock, and by their numbers frequently enliven the view. Roman coins have been found in this neighbourhood; but there are no vestiges of their having been any station. Beyond Castell-mawr, on the shore, are vast blocks of black marble filled with shells, coralloids, and fungitæ.

At Tresclwyn mountain is the most considerable body of copper ore perhaps ever known. The part of Tryfclwyn which contains it is called *Parys mountain*. Of this mountain, and the works there carried on, we have the following very curious and particular account by Mr Pennant *:—"The external aspect of the hill is extremely rude, and rises into enormous rocks of coarse white quartz. The ore is lodged in a bason or hollow, and has on one side a small lake, on whose waters, distasteful as those of Avernus, no bird is known to alight. The whole aspect of this tract has, by the mineral operations, assumed a most savage appearance. Suffocating fumes of the burning heaps of copper arise in all parts, and extend their baneful influence for miles around. In the adjacent parts vegetation is nearly destroyed; even the mosses and lichens of the rocks have perished; and nothing seems capable of resisting the fumes but the purple melic grass, which flourishes in abundance. It is thought that the ore had been worked in a very distant period. Vestiges of the ancient operations appear in several parts, carried on by trenching, and by heating the rocks intensely, then suddenly pouring on water, so as to cause them to crack or scale; thus aukwardly supplying the use of gunpowder. Pieces of charcoal were also found, which proves that wood was made use of for that purpose. As the Britons imported all works in brass, it is certain that the Romans were the undertakers of these mines; and it is very probable that they sent the ore to Caerhên to be smelted, the place where the famous cake of copper was discovered. They might likewise have had a smelting-hearth in this island; for a round cake of copper was discovered at Llanvaethlle, a few miles from this place. Its weight was fifty pounds, and it had on it a mark resembling an *L*.

* *Tour in Wales*, ii. 263.

"In the year 1762, one Alexander Frazier came into Anglesey in search of mines. He visited Parys mountain; called on Sir Nicholas Bayley, and gave him so flattering an account of the prospect, as induced him to make a trial, and sink shafts. Ore was discovered; but before any quantity could be gotten, the mines were overpowered with water. In about two years after, Messrs Roe and Co. of Macclesfield, applied to Sir Nicholas for a lease of Penrhyn ddu mine in Caernarvonshire; with which they were, much against their wills, compelled to take a lease of part of this mountain, and to carry on a level, and make a fair trial. The trial was accordingly made; ore was discovered; but the expences overbalanced the profits. They continued working to great loss; and at length determined to give the affair up. They gave their agent orders for that purpose; but he, as a final attempt, divided his men into ten several companies, of three or four in a partnership, and let them sink shafts in various places, about eight hundred yards eastward of a place called the *Golden Venture*, on a presumption that a spring, which issued from near the place, must come from a body of mineral. His conjecture was right; for in less than two days they met with, at the depth of seven feet from the surface, the solid mineral, which proved to be that vast body which has since been worked to such advantage. The day that this discovery was made was March 2d, 1768; which has ever since been observed as a festival by the miners. Soon after this discovery, another adventure was begun by

Anglesey. by the reverend Mr Edward Hughes, owner of part of the mountain, in right of his wife Mary Lewis of Llys Dulas; so that the whole of the treasure is the property of Sir Nicholas Bayley and himself. The body of copper ore is of unknown extent. The thickness has been ascertained in some places by the driving of a level under it, several years ago, and it was found to be in some places twenty-four yards. The ore is mostly of the kind called by Cronsted *Pyrites cupri flavo viridescens*, and contains vast quantities of sulphur. It varies in degrees of goodness; some of it is rich, but the greater part poor in quality.

"There are other species of copper ore found here. Of late a vein of the *Pyrites cupri griseus* of Cronsted, about seven yards wide, has been discovered near the west end of the mountain: some is of an iron grey, some quite black; the first contains sixteen lb of copper per ctb. the last forty. An ore has been lately found, in form of loose earth, of a dark purplish colour; and the best of it has produced better than eight in twenty. Some years ago, above thirty pounds of native copper was found in driving a level through a turbery; some was in form of moss, some in very thin leaves.

"It is quarried out of the bed in vast masses; is broken into small pieces; and the most pure part is sold raw, at the rate of about 3*l*. to 6*l*. per ton, or sent to the smelting-houses of the respective companies to be melted into metal. Mr Hughes has great furnaces of his own at Ravenhead, near Liverpool, and at Swansey, in South Wales. An idea of the wealth of these mines may be formed, by considering that the Macclesfield company have had at once fourteen thousand tons of ore upon bank, and Mr Hughes thirty thousand.

"The more impure ore is also broken to the size of about hen's eggs; but in order to clear it from the quantity of sulphur with which it abounds, as well as other adventitious matter, it must undergo the operation of burning. For that purpose, it is placed between two parallel walls of vast length: some kilns are 20, others 40, and 50 yards in length; some 10, others 20 feet wide, and above 4 feet in height. The space between is not only filled, but the ore is piled many feet higher, in a convex form, from end to end. The whole is then covered with flat stones closely luted with clay, and above is placed a general integument of clay, and small rubbish of the work, in order to prevent any of the fumes from evaporating. Of late, some kilns have been constructed with brick arches over the ore, which is found to be the best method of burning. Within these few years, attempts are made to preserve the sulphur from flying away; and that is done by flues made of brick, whose tops are in form of a Gothic arch, many scores of feet in length. One end of these opens into the beds of copper which are to be burnt. Those beds are set on fire by a very small quantity of coal, for all the rest is effected by its own phlogiston. The volatile part is confined, and directed to the flues; in its course the sulphureous particles strike against their roofs, and fall to the bottom in form of the finest brimstone; which is collected and carried to adjacent houses, where it is melted into what is called in the shops *stone brimstone*.

"The beds of copper, thus piled for burning, are of vast extent. Some contain 400 tons of ore, others 2000. The first require four months to be completely burnt, the last near ten. Thus burnt, it is carried to proper places to be dressed, or washed, and made merchantable. By this process the ore is reduced to a fourth part in quantity, but considerably improved in quality: and by this means the water is strongly or richly impregnated with copper, which is dissolved by the acid quality of the sulphur; and is collected or precipitated again by iron in the above-described pits. The iron is all dissolved.

"But a far richer produce of copper is discovered from the water lodged in the bottom of the bed of ore, which is highly saturated with the precious metal. This is drawn up, either by means of whimsies or windmills, to the surface, and then distributed into numbers of rectangular pits 36 feet long, some pits more, some less, 12 or 15 feet broad and 20 inches deep. To speak in the language of the adept, Venus must make an assignation with Mars, or this solution will have no effect. In plain English, a quantity of iron must be immersed in the water. The kind of iron is of no moment; old pots, hoops, anchors, or any refuse will suffice: but of late, for the convenience of management, the adventurers procure new plates, four feet long, one and a half broad, and three quarters of an inch thick. These they immerse into the pits. The particles of copper instantly are precipitated by the iron, and the iron is gradually dissolved into a yellow ocher. Great part of it floats off by the water, and sinks to the bottom. The plates, or the old iron (as it happens), are frequently taken out, and the copper scraped off; and this is repeated till the whole of the iron is consumed. The copper thus procured differs little from native copper, and is prized accordingly, and sold for prices of £. 25 to £. 45 a ton.

"This discovery is far from new: it has been practised long in the Wicklow mines in Ireland; and above a century in those of Hern-grundt in Hungary, where it is called *ziment copper*. The waters of the Hungarian mines are much more strongly impregnated with copper than those of Parys mountain. The first effects its operation in 12 or about 20 days, the last requires two months. Horse-shoes, iron made in the shape of hearts, and other forms, are put into the foreign waters; and when perfectly transmuted, are given as presents to curious strangers.

"The ore is not got in the common manner of mining, but is cut out of the bed in the same manner as stone is out of a quarry. A hollow is now formed in the solid ore open to the day, and extends about 100 yards in length, about 40 yards in breadth, and 24 yards in depth. The ends are at present undermined, but supported by vast pillars and magnificent arches, all metallic; and these caverns meander far under ground. These will soon disappear, and thousands of tons of ore be gotten from both the columns and roofs. The sides of this vast hollow are mostly perpendicular, and access to the bottom is only to be had by small steps cut in the ore; and the curious visitor must trust to them and a rope, till he reaches some ladders, which will conduct him the rest of the descent. On the edges of the chasms are wooden platforms, which project far; on them are windlasses, by which the workmen are lowered to transact their business on the face

of

of the precipice. There suspended, they work in mid air, pick a small space for a footing, cut out the ore in vast masses, and tumble it to the bottom with great noise. In such situations they form caverns, and there appear safely lodged till the rope is lowered to convey them up again. Much of the ore is blasted with gunpowder, eight tons of which are said to be annually used for the purpose.

"Nature hath been profuse in bestowing her mineral favours on this spot: for above the copper ore, and not more than three quarters of a yard beneath the common soil, is a bed of yellowish greasy clay, from one to four yards thick, containing lead ore, and yielding from 600 to 1000 pounds weight of lead from one ton; and one ton of the metal yields not less than 57 ounces of silver. Mixed with the earth are frequently certain parts of the colour of cinnabar. Whether these are symptomatic of the sulphureous arsenical silver ores or of quicksilver, I will not pretend to decide. Something interferes with the successful smelting of this earth in the grate; insomuch that it has not yet been of that profit to the adventurers which might reasonably be expected from the crucible-assays of it, and they have at this time about 8000 tons on bank undisposed of. This place has been worked for lead ore in very distant times. In the bottom of the pool was found an ancient smelting-hearth of grit-stone, and several bits of smelted lead, of about four inches in length, two in breadth, and half an inch thick.

"These works have added greatly to the population of the island; for about 1500 persons are employed; who, with their families, are supposed to make near 8000 persons, getting their bread from these mines. The little village of Amlwch, the port of the place, is increasing fast, and the market grows considerable. At the season of the greatest work, Mr Hughes's men alone receive for many weeks £. 200 in one week, and £. 150 in another, merely for subsistence. The port is no more than a great chasm between two rocks, running far into land, and dry at low-water; into which sloops run, and lie secure to receive their lading."

Near Kemlyn Bay is a quarry of marble, common to this place, some parts of Italy, and to Corsica, and known in the shops by the name of *Verde di Corsica*. Its colours are green, black, white, and dull purple, irregularly disposed. In different blocks one or other of the colours are frequently wanting; but among the green parts are often found narrow veins of a most elegant and silky white asbestos. It is a compound species of marble: part is calcareous and may be acted on by aquafortis. The green parts partake of the nature of jasper. It is apt to be intersected by small cracks, or by asbestine veins, therefore incapable of taking a high polish. This quarry lies on the lands of Monachty, in the parish of Llan-Fair-Ynghornwy; and it is found again in the isle of Skerries, off this parish. Neither the quarry not the asbestos are at present in use. In Rhoscolyn parish, a green amianthus, or brittle asbestos, is met with in great plenty in a green marble similar to the above; but by reason of the inflexible quality of its fibres not applicable to the same use.

ANGLING, among sportsmen, the art of fishing with a rod, to which are fitted a line, hook, and bait. See FISHING-*Rod*, FISHING-*Hook*, FISHING-*Fly*.

The angler's first business is to attract the fish to the place intended for angling. The method of doing this, in standing waters, by throwing in grain, chopped worms, and the like, is well known: but the chief difficulty is in running rivers and brooks. The method, in this case, is to prepare a tin box capable of holding some hundreds of worms, bored on all sides, and full of holes of such a size as they may be just able to crawl out at; there must be a plummet fastened to this box to sink it, and a line to draw it back at pleasure; in this case it is to be thrown into the water in a proper place, above which the angler may stand under cover. The worms will slowly and gradually crawl out of this box, and the fish will be gathered about to feed on them; the baited hook is to be thrown in higher up and carried down by the stream. If this method do not bring the fish about the place in a little time, there is reason to suspect that some pike lies lurking thereabout, and deters them: in this case, it is proper to throw out a baited hook, and he will generally be taken; after this the attempt will succeed.

When the angler takes his stand, he is to shelter himself under some tree or bush, or stand so far from the brink of the water that he can only discern his float; as the fish are timorous and easily frighted away. The angling rod must be kept in a moderate state, neither too dry nor too moist: in the first case it will be brittle; in the other rotten. When pastes are used, it is proper to mix a little tow with them, and rub them over with honey; finally, a small anointing with butter is of great use to keep them from washing off the hook. The eyes of any fish that is taken are an excellent bait for almost any other kind of fish. The best way of angling with the fly is down the river, and not up; neither need the angler ever make above half a dozen of trials in one place, either with fly or ground bait, when he angles for trout: by that time the fish will either offer to take, or refuse the bait and not stir at all.

In a pond, the best place for the angler to take his stand is usually that where the cattle go up to water: in rivers, if breams are fished for, it should be in the deepest and most quiet places; if eels, under the banks of rivers that hang over; perch are to be expected in clean places, where the stream is swift; and chub in deep shaded holes: roach are mostly found where the perch are, and trout only in swift and clear streams. Places where there are many weeds, or old stumps of trees, harbour fish in great numbers, and they usually bite freely there; but there is danger of entangling the line, or fastening the hook to the weeds. In case of this accident, recourse is to be had to a ring of lead, of about six inches round, fastened to a small pack-thread: this ring is to be thrust over the rod, and let fall into the water. It will descend to the place where the hook is entangled; and then, by pulling the pack-thread gently, the hook will be soon disengaged, or at the worst it can only be broke off near the end of the line; whereas, when this is not employed, the rod itself is sometimes broken, or the line nearer its upper end.

Deep waters are best for angling in, for the fish do not love to be disturbed by wind and weather.

The

The openings of sluices and mill-dams always bring fish up the current to seek for the food which is brought with the stream; and angling in these places is usually successful.

The best season is from April to October; for, in very cold stormy weather, the fish will not bite: the best times of the day are from three till nine in the morning, and from three in the afternoon till sun-set. In an easterly wind, there is never much sport for the angler; the southerly winds are the best for his purpose, and a warm but lowering day is most of all to be chosen; a gentle wind, after a sudden shower, to disturb the water, makes a very good opportunity for the angler: the cooler the weather in the hottest months, the better; but in winter, on the contrary, the warmer the day the better. A cloudy day, after a bright moonlight night, is always a good day for sport; for the fish do not care for going after prey in the bright moonshine, and are therefore hungry the next morning.

Those who are fond of angling might save themselves some fruitless trouble, by observing when small fish in a jar take or refuse food. See FISH.

The several methods of angling for salmon, trout, carp, tench, pearch, pike, dace, gudgeons, roach, flounder, &c. may be seen under the article FISHING.

ANGLO-CALVINISTS, a name given by some writers to the members of the church of England, as agreeing with the other Calvinists in most points except church-government.

ANGLO-Saxon, an appellation given to the language spoken by the English Saxons: in contradistinction from the true Saxon, as well as from the modern English.

ANGLUS (Thomas), an English priest, well known for the singularity of his opinions, and several little tracts which he wrote in the 17th century. He went by several names. Mr Baillet says his true name was *White*; but that he used to disguise it under that of *Candidus*, *Albus*, *Bianchi*, and *Richworth*: but he was most known in France by the name of *Thomas Anglus*. Des Cartes generally called him Mr *Vitus*. He passed some time in most countries of Europe; but his longest stay was at Rome and Paris. When he was in England, he lived a considerable time in the family of Sir Kenelm Digby; and seems to have had a great esteem for the opinions of this gentleman, as may be seen in his writings, particularly in the Preface to his Latin work concerning the Institutions of the Peripatetic Philosophy, according to the hypothesis of Sir Kenelm. He was a great advocate for the peripatetic philosophy. He attempted even to make the principles of Aristotle subservient to the explaining the most impenetrable mysteries of religion; and with this view, he engaged in the discussion of predestination, free-will, and grace. Mr Baillet says, "What he wrote upon this subject resembles the ancient oracles for obscurity." In such abstruse points as we have mentioned, he was much embarrassed; and, by giving too great scope to his own thoughts, he pleased neither the Molinists nor Jansenists. He is allowed, however, to have been a man of an extensive and penetrating genius. On the 10th of June 1658, the congregation of the Index Expurgatorius at Rome condemned some treatises of Thomas Anglus. The doctors of Douay censured also 22 propositions extracted from his Sacred Institutions. He published his *Supplicatio postulativa justitiæ*, in opposition to their censure; wherein he complains that they had given him a vague undetermined censure, without taxing any particular proposition. He died some time after the restoration of Charles II. but in what year is uncertain.

ANGOL, a city of Chili in South America, situated in W. Long. 78°. and S. Lat. 38°.

ANGOLA, a kingdom on the western coast of Africa, lying, according to the most probable accounts, between Lat. 8. 30. and 16. 21. South, forming a coast of upwards of 480 miles; but how far it extends from west to east, has never been exactly determined. Angola Proper is bounded on the north by the river Danda, which separates it from Congo; and on the south by the Coanza, by which it is separated from Benguela. This last, however, is now included in the kingdom of Angola, having been conquered by its monarchs, tho' it still retains the name of kingdom, and is included in the dimensions we have just now given. The air here is very hot and unwholesome, and the country mountainous; there being but few plains to be met with in it, except on the sea-coast, and between the huge ridges of mountains.

1 Originally a province of Congo.

That part of the kingdom which we have distinguished by the name of *Angola Proper*, was subject to the kings of Congo in the year 1484, when the Portuguese first discovered the country: but how long it had been so before that time, is not known; the inhabitants being utterly destitute of chronology, and have no other way of distinguishing past events but by saying they happened in such a king's reign. Neither, though Angola became a distinct kingdom since its discovery by the Portuguese, is it known with more certainty at what time that revolution happened; or whether the Portuguese were not concerned in assisting the viceroy of the king of Congo, who governed the province of Angola, to set up for himself.

2 Tradition concerning its becoming a distinct kingdom.

All accounts agree, that this kingdom was founded by one *Ngola*, or *Angola*, from whom it took its name. According to the tradition of the country, this Ngola was a smith, and the inventor of that trade, in which he had been instructed by the dæmons of the country. In consequence of this, he became exceeding rich, not in gold, silver, or shell-money, which were not at that time in use; but in corn, cattle, and fruits, which were then exchanged in traffic. The country being not long after visited by a grievous famine, Ngola generously relieved his distressed countrymen, and saved the lives of some thousands. In gratitude for this generosity, he was unanimously chosen king; and hence the smith's trade is reckoned among the royal arts of Angola.

3 More authentic account.

According to other accounts which can be more depended upon, Ngola was the king of Congo's viceroy; who, having become powerful by the reduction of several of the neighbouring states, was induced to set up for himself. Dreading, nevertheless, the power of his old master, he chose to send him the usual tribute and presents annually, till he reckoned himself firmly seated on the throne, and had secured it to his descendents. His measures were greatly facilitated by the wars which the king of Congo was then engaged in with the *Giagas*, a barbarous nation in the neighbourhood. These made such a powerful inroad into his dominions, that he was glad to ask assistance from Ngola; not as a subject, but

Angola. as a friend and ally. This was readily granted; and the two monarchs continued ever after sending presents and assistance to each other, and encouraging a mutual commerce between their subjects.

4 Ngola the first king. Ngola lived to a great age, highly respected by his subjects, and in alliance with the king of Congo and the Portuguese, whose numerous settlements on the coast had made them become very powerful. According to the custom of the country, he had many wives and concubines. By his chief favourite he had three daughters, *Zunda Riangola*, *Tumba Riangola*, and another whose name is unknown. Towards the latter part of his life, the king's chief care was to secure the crown to the eldest of these; for which purpose he consulted his beloved queen, who encouraged him in the design with all the eloquence in her power. By her advice, he sent for his lieutenant-general; a favourite slave, whom he had created viceroy over the whole kingdom, to acquaint him with his resolution. The artful minister did not fail to applaud his design, though his intention was to defraud the princess, and seize the throne for himself. He accordingly took the opportunity, one day, when that princess and the whole court were employed in sowing their lands, to spread a report that the Angolic enemies had entered the kingdom, and were destroying every thing with fire and sword. In this confusion, the treacherous viceroy conducted the three princesses to the royal palace; and acquainting Ngola with the pretended danger, urged him

5 Murdered by his prime minister, who seizes the throne. to betake himself to a speedy flight. The frighted monarch, unable to stir with age, desired his minister to take the most proper means for his safety: whereupon, being a stout young fellow, he takes his majesty on his back, and carries him into a neighbouring wood; where he no sooner had him in a convenient place, than he stabbed him with a dagger. This stratagem was too shallow to remain long concealed; the murderer was quickly discovered, and many of the nobles rose in arms against him; but finding his party too strong to be opposed, they were at last obliged to submit, and suffer him quietly to ascend the throne, upon his publicly declaring that he had not seized it but with a view of securing it to the princess Zunda Riangola.

To this princess, the usurper palliated his conduct in the best manner he could; and she had art enough to disguise her resentment so effectually, that he never

6 Death of the usurper, who is succeeded by Zunda Riangola. discovered the smallest occasion for jealousy. At last, his sudden death gave Zunda an opportunity of ascending the throne peaceably; when she behaved with such moderation and justice, as to gain the love and affection of all her subjects. Her jealous temper prevented her from marrying; and, by giving too much way to it, she came at last to dread as rivals the two sons of her younger sister Tumba, and to form designs against their life. To accomplish her purposes, she ordered them to be brought to court, pretending to have them educated under her own eye. This was declined for some time; but at length the queen prevailed so far as to have the eldest sent to her; whom she no

7 Murders her nephew. sooner got into her power, than she caused him to be massacred, with all his attendants; only one escaping, all covered with wounds, to carry the dreadful news to the princess and her husband.

On hearing of this bloody act, the afflicted parents immediately sallied forth at the head of all their vassals. They were waited for by Queen Zunda at the head of a numerous army; but, no sooner did her soldiers perceive the parents of the deceased prince, than they immediately abandoned the queen to their resentment.

8 Is herself murdered by her sister. Tumba immediately rushed upon her sister, and stabbed her to the heart; after which, she commanded her entrails to be taken out, and thrown into the hole in which her son's body had been cast. Upon this Tumba was crowned queen of Angola, and invited her husband to participate with her in the management of public affairs. This offer he was too wise to accept; and Tumba, upon his refusal, resigned the crown into the hands of her surviving son, named *Angola Chilvagni*. He proved a great and wise prince, extending his dominions by conquest, and gaining the love of his subjects by the moderation and equity of his government. He was succeeded by one of his younger sons, named *Dambi Angola*; who no sooner ascended the throne,

9 Dambi Angola a cruel tyrant. than he put all his brethren to death, lest they should unite in favour of the eldest. The rest of his reign proved conformable to such a beginning. He was a monster of cruelty, avarice, lewdness, and perfidy. Death, however, in a short time, happily delivered his subjects from this tyrant; who, notwithstanding his infamous life, was buried with the greatest magnificence; and a mount was erected over his grave, consisting, according to the custom of the country, of a prodigious nnmber of human victims which had been sacrificed to his ghost. Dambi Angola was succeeded by Ngola Chilivagni, a warlike and cruel prince. He

10 Ngola Chilivagni; his conquests. conquered many nations, and made the most dreadful inroads into the kingdom of Congo, along the rivers of Danda, Lucalla, Zanda, and Coanza; whose waters were often tinged with the blood of thousands whom he massacred in his excursions. Notwithstanding these butcheries, Ngola Chilivagni showed such generosity to those who readily submitted to him, that he was sure to conquer, not only wherever he came, but wherever he seemed to direct his forces. At last, as if weary of conquest, he planted a tree on the banks of the Coanza, about eight leagues from Loanda San Paulo, as a boundary to his ravages. This tree the Portuguese called *Isanda*, or *Isandaura*; and afterwards erected a fortress near it.

11 Fancies himself a god. The same folly and insolence which took place in the breast of Alexander the Great, on account of his rapid conquests, soon puffed up the mind of this petty African tyrant. Because he had conquered and ravaged some of the neighbouring countries, and brought under his subjection a few cowardly barbarians; he first fancied himself invincible, and then that he was a god. He demanded the same respect and adoration that was paid to their other deities; and with this demand his subjects were servile enough to comply. This pretended deity, however, was forced to submit to the fate of other mortals, and died without leaving a successor behind him.

On the decease of Ngola Chilivagni, the states elected Ngingha-Angola-Chilombo-Kickasanda, great-nephew to queen Tumba's husband, as his successor. He proved such a rapacious and cruel tyrant, that his subjects universally wished for his death; which, luckily for them, soon happened. He was interred with the usual pomp and solemnities, particularly that of having a whole hecatomb of human victims sacrificed upon his grave.

Angola.

grave. His son Bandi Angola, who succeeded him, proved yet a greater tyrant than his father; so that he soon became intolerable to his subjects. A general revolt ensued, in which his subjects called in the cannibal Giagas to their assistance. They immediately poured in like a band of hungry dogs hastening to feed upon a carcase; and having defeated and devoured the forces of the tyrant, besieged him in an inaccessible mountain; where not being able to come at him, they resolved to reduce him by famine. Bandi Angola applied to the king of Congo for assistance. As it was the interest of that prince to hinder the ravenous Giagas from entering into the Angolic dominions, whence they could so easily pass into his own, he did not hesitate at granting his request; and ordered a strong reinforcement of the Portuguese, of whose valour he had a high opinion, and of whom he entertained a great number at his court, to march to the assistance of the king of Angola. The command of the army was given to one of the most experienced Portuguese officers; who, depending more on the handful of Europeans he had under his command than on the Congoese, attacked the rebels, though greatly superior in number; and, having utterly defeated them, restored the king of Angola to his throne.

12 Revolt against Bandi Angola.

13 Quelled by the assistance of the king of Congo and the Portuguese.

This essential piece of service so endeared the Portuguese to Bandi Angola, that he took them into his service, and even into his council. Their general became a great favourite of the king, but much more so of his daughter, who conceived a violent passion for him Unfortunately for them both, the amour was carried on with so little precaution on her part, that the king quickly discovered it; and immediately formed a resolution of exterminating the Portuguese all at once. Such violent measures, however, could not be concerted so privately but the princess got some intelligence of it; and having apprised her lover of the danger, he immediately withdrew into Congo, taking with him as many of his countrymen as he conveniently could. The king of Congo expressed such strong resentment against Bandi Angola for his ingratitude, that the Portuguese general would have probably prevailed upon him to declare war against Angola, had he not been obliged to defend his own dominions against a neighbouring prince who then made an invasion. This afforded that general a fair pretence of asking leave to return home; promising to come with such reinforcements as would enable the king of Congo to revenge himself for the affront put upon him by the Angolic monarch. His real intention, however, was, to give the king of Portugal an opportunity of seizing upon the kingdom of Angola.

14 The king's daughter falls in love with the Portuguese general;

15 Who retires to Congo.

On his return to Lisbon, the Portuguese general having laid his plan before the king, it was so well relished, that an armament was ordered to be fitted out, well furnished with every necessary for building fortresses, &c. and a sufficent number of men. The wind proving favourable all the way back, the Portuguese soon arrived safe at Loando San Paulo; whence the general dispatched a messenger to acquaint the king of Congo with his arrival, and to make him some rich presents. These were no sooner gone than the admiral sailed up the Coanza; and, landing without opposition in the kingdom of Angola, set about erecting a fortress in a convenient situation, which was completed in a few days.

16 Lays a plan for the conquest of Angola before the king of Portugal.

The king being informed of the return of the Portuguese, and of their fortifying themselves on advantageous ground, gathered together a numerous army: but his forces though upwards of 100,000 in number, were utterly defeated by the Portuguese; vast numbers killed, and many more carried into slavery. The admiral now ravaged the whole country, putting all to fire and sword, and making himself master of every advantageous spot of ground. The king, however, had still the good luck to escape all the stratagems that were laid for him; and once more got safe to his inaccessible fortress.

17 Defeats the Angolans.

All this time Bandi Angola had himself tyrannized, and allowed his favourites to tyrannize, in such a manner, that his subjects were become no less weary of his government than when they formerly revolted. Being now exasperated beyond measure at the calamitous war of which he had been the occasion, they formed a design of putting an end to his life; and in order to draw him out of his retreat, where he wallowed in all manner of debauchery, they had recourse to the following stratagem: A deputation was sent, acquainting him with the revolt of one Cuculo Cabazzo; who, at the head of a numerous band, committed the most cruel ravages. They besought his majesty either to levy a sufficient number of troops, and march in person against him, or to allow them to arm themselves against him. The credulous king complied with this last proposal; and granted them leave to raise what forces might be thought necessary. Four days after, notice was sent to the king, that his subjects had attacked the rebels, and had been repulsed with loss; but that, if his majesty would but condescend to animate them with his presence, the sight of him would inspire them with such courage, that they would assuredly prove victorious. This had the desired effect; and the king set out a few days after, without any other precaution than his own guards, to head his army which was encamped on the banks of the Lucalla. He no sooner appeared in view, than all the chief officers came out to meet him; and having under pretence of paying their respects, gradually separated him from his guards, they fell upon him and dispatched him at once.

18 Bandi Angola murdered.

Bandi Angola was succeeded by his son Ngola Bandi, whose mother had been a slave; and whose title to the crown was consequently disputable, according to the laws of the country. Of this the new king being well apprised, thought proper to begin his reign by murdering every person who had opposed his election. He began with the *Tendula*, or commander of the king's rear-guard; who, by his office, is the chief of the electors, and the person who governs the kingdom during the interregnum. Him he ordered to be put to death, with all his family. These were followed by the principal officers of his father's court; all his concubines, together with their parents and near relations, whom he caused to be butchered; together with his half-brother. his father's son by a favourite concubine, and then but an infant. He did not spare even the son of his sister Zingha Bandi, whom she had by one of her paramours. The interest of his sister had contributed greatly to raise this tyrant to the throne; and his ingratitude

19 Cruelty of the new king.

Angola. gratitude, with the murder of her son, so exasperated her, that she swore to be revenged on him in the same way.

20 Makes war on the Portuguese and is reduced to great distress. The Portuguese were the next objects of his resentment. These he so much dreaded on account of their valour and policy, that he immediately declared war, resolving not to lay down his arms till he had exterminated them to the last man, or driven them totally out of his dominions. His rashness, however, cost him dear. Myriads of the Angolic poltroons were overthrown by an handful of Portuguese; and the king himself was forced to fly, first into the island of Chiconda in the river Coanza, and then into the desarts of Oacco. Here his conquerors, out of great clemency, allowed him to live among the wild beasts, without any other sustenance than what the desarts afforded. He had the misfortune also to lose his queen and two sisters Cambi and Fungi, who were taken prisoners by the Portuguese, but honourably treated.

The king being informed of this, sent an embassy to treat of their ransom and an exchange of prisoners. The proposal was readily agreed to; and the princesses were sent back, laden with presents. The king,

21 His treachery. however, refused to perform his part of the agreement, and thereby plunged himself into still greater difficulties. A new Portuguese viceroy being arrived about this time, Ngola was quite at a loss how to excuse the non-performance of his part of the treaty. At last

22 Sends his sister Zingha on an embassy. he had recourse to his exasperated sister Zingha; and having excused, as well as he could, the murder of her son, proposed to send her on a splendid embassy to the viceroy. Having consented, but without forgetting her resentment, she set out, as plenipotentiary for the king of Angola, with a magnificent retinue, was received with all the honour due to her rank, and lodged in a splendid palace prepared for her.

23 Her haughty behaviour. At the first audience Zingha had of Don John (the Portuguese viceroy), she was greatly surprized to find a stately elbow-chair prepared for him to sit upon, and for herself only a rich tapestry spread on the floor, with a velvet cushion embroidered with gold, and placed over against the chair of state. Dissembling her displeasure however, she beckoned to one of the ladies of her retinue, commanded her to lay herself down on her elbows and knees upon the carpet, and sat herself upon her back during the whole time of the audience. She behaved with such address and dignity, as to gain the admiration of the whole council. A proposal was made of entering into an alliance offensive and defensive with the king of Angola, provided he acknowledged himself the vassal of the king of Portugal, and submitted to pay a yearly tribute. To this Zingha replied, that such conditions were indeed fit to be imposed upon those who had been conquered by the sword; but not upon a great and powerful monarch, who only sought their friendship and alliance: upon which the treaty was concluded on both sides, without any other conditions than the exchange of prisoners. The audience being over, Don John took notice to Zingha, as he conducted her out of the hall, that the lady who had served her as a seat, continued still in the same posture; upon which she replied, That it did not become the ambassadress of a great monarch to make use of the same chair twice, so she looked upon her as a piece of cast-off goods not worthy of further notice.

Zingha was so taken with the honours done her by the Portuguese, and so intent upon observing the order, dress, arms, &c. of their troops, that she staid at Loando a considerable time; during which she was instructed in the Christian religion, and consented to be baptized. Don John and his spouse were her sponsors; who dismissed her soon after, with all possible honours, and highly satisfied with her reception and success. At her return she took care to have the articles ratified by her brother; who expressed his approbation of them, and the highest obligations to her. He even went so far as to desire the viceroy to send him some proper persons to instruct him in the Christian religion, which he said he was very desirous of embracing. This request was immediately granted; and Don Denis de Faria, a negro priest, a native of Angola, was dispatched, along with an officer of distinction, to stand godfather to the king. These met at first with a gracious reception; but when they come to talk of baptism, Ngola altered his tone, and told him it was too much below his dignity to receive it from the son of one of his slaves, and sent them both back. This was cried up by the courtiers as a princely act: but Zingha represented that it could not fail to exasperate the viceroy; and tried all possible means to dissuade him from it, but in vain. He suffered, however, his other two sisters, Cambi and Fungi, to be baptized; which was performed in 1625, with a splendor suited to their dignity. Angola. 24 Embraces the Christian religion.

As no experience seems to have been a sufficient antidote against the innate folly of Ngola Bandi, he soon after took it into his head to make war on the Portuguese and invaded some of their territories. This last action proved his ruin: his troops were all cut off, and himself forced to swim for his life to a small island in the Coanza, about a mile long, and two bow-shots in breadth; whither the Portuguese pursued and surrounded him, so that he had no other chance, but either to fall into their hands, or be devoured by the wild beasts with which the place swarmed. From both these dangers he was relieved by a dose of poison, given him, as was supposed by his sister Zingha. Before this time, however, he had taken care to send his eldest son to the country of the Giagas, and put him under the care of one of their chiefs called *Giaga Caza*, whom he besought to take care of him and protect him from his aunt Zingha, as he rightly imagined she would not fail of attempting his life, in order to secure herself on the throne. 25 War again declared against the Portuguese 26 The king poisoned.

Zingha Bandi was crowned queen of Angola, without opposition, in 1627—She was a very artful woman, endowed with great presence of mind, firm in her resolutions, of an intrepid courage, and a great mistress in the art of dissimulation. She inherited a large share of her brother's jealous and cruel temper, to which she would not hesitate to sacrifice her nearest relations, if they gave her the least umbrage.—To this jealousy therefore she resolved to sacrifice her nephew, as well knowing he had a better title to the crown than herself. She made use of the most solemn oaths to draw him out of the hands of his guardian, protesting that she had accepted of the throne with no other view than to preserve it for him. But Giaga, being well acquainted with her temper, was proof against all her oaths and fair speeches—Zingha, finding this method ineffectual, pretended 27 Zingha Bandi crowned queen.

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pretended a desire of resigning the crown to her nephew; to which she said she had no other objection, than that she was afraid he was yet incapable of assuming the reins of government. She therefore desired an interview with him, though ever so short that she might satisfy herself in this particular, and promised to detain him no longer than Giaga should think necessary. Giaga thought there could be no danger in consenting to a short interview; and therefore sent the unfortunate

28 She murders her nephew.

prince to her, attended by a magnificent retinue. The cruel queen no sooner got him in her power, than she murdered him with her own hand, and caused his body to be thrown into the Coanza, ridding herself, by that inhuman act, of a formidable rival, as well as revenging herself on her brother, as she had sworn to do, for the murder of her son.

Zingha's next scheme was to rid herself of the Portuguese, who had established themselves in such a manner as to be almost entire masters of the country. They had built fortresses on every convenient spot that suited them, especially near her principal towns, which they could level with the ground with the greatest ease. They had engrossed all her commerce, were become very wealthy, and their numbers increased daily; so that they were dreaded not only by her subjects, but by all the neighbouring nations. As Zingha was of a

29 Declares war against the Portuguese.

martial temper, she did not long hesitate. She quickly made all necessary provisions, strengthened herself by alliances with the Giagas, and other idolatrous nations, and even with the Dutch and the king of Congo, With this combined force she attacked the Portuguese so suddenly and unexpectedly, that she gained some advantages over them; and the Dutch made themselves masters of San Paulo de Loando, and soon after of some of the best provinces in the kingdom. This happened in the year 1641; and the Portuguese did not recover these places till the year 1648, when the Dutch were entirely driven out of Angola.

30 Her bad success.

Zingha's successes proved still more short-lived. Her allies the Congoese were so completely overthrown, that they were forced to sue for peace; which the Portuguese did not grant till they had obtained a sufficient number of hostages, and obliged the Congoese to deliver up to them some considerable posts, upon which they immediately erected fortresses. Zingha's troops were now defeated in every battle; and these defeats followed one another so close, that she was soon abandoned, not only by her allies, but by her own troops. She was now constrained to abandon her dominions, and retire to some of the eastern deserts, whether the Portuguese did not think it worth while to follow her.

Zingha being reduced to such distress, the Portuguese, after giving her some time to ruminate on her situation, sent her proposals of peace, upon condition that she should become tributary to the crown of

31 Refuses to become tributary to them.

Portugal. This proposal was rejected with scorn; and she let them know, that, however her dastardly subjects might submissively and shamefully behave towards them, their queen disdained subjection to any foreign power. On this haughty answer, the Portuguese, to mortify

32 They set up a king.

her still more, set up a king in her place. The person they pitched upon was named *Angola Oarij*, or *Aaru*, who was of the royal family. Before he was crowned, the Portuguese obliged him to turn Christian; and he was accordingly baptized by the name of John. The new king, however, soon died of grief, at seeing himself so hardly treated by his new masters the Portuguese, they quickly set up another, named *Philip;* who bore the yoke with more patience, and lived to the year 1660.

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33 Zingha's apostacy and horrid barbarity.

In the mean time Zingha, exasperated at seeing herself deprived of eleven of the best provinces in her dominions, and her authority in the remaining six greatly weakened, renounced the Christian religion, and embraced all the horrid and bloody customs of the Giagas, whom she outdid even in their own barbarity.—We have already hinted the barbarity of this nation in eating human flesh. In this Zingha not only joined them, but took pleasure in devouring the raw flesh of human victims, and drinking their blood while warm, both at her sacrifices and at her public meals.—She affected a martial and heroic spirit, together with an utter aversion to the male sex; but, according to the Portuguese, maintained a number of the strongest and lustiest youths, in whose embraces she gave a full scope to her inclinations, and managed matters with such secrecy that her intrigues could never be discovered. At the same time she ordered many of her own sex to be ripped up, when their incontinency was manifested by their pregnancy; and their bodies, with those of the infants, to be cast to wild beasts.

But what made her most admired, as well as dreaded, by her subjects, was a notion that she had by various stratagems inculcated upon them, of her being able to penetrate into the most secret thoughts. To keep up this apprehension, she ordered the bones of her deceased brother to be brought from the island where he was poisoned, locked up in a chest covered with coarse plates of silver, and laid on a fine carpet upon a pedestal. A number of singhillos or priests were ordered to offer sacrifices to these bones, and to keep lamps continually burning before them. To this place she herself frequently repaired, to assist at those rites, which, as she gave out, and every body believed, engaged the spirit of the deceased to inform her of every thing that was done, said, or even designed, either in the kingdom or out of it.—To procure, however, as much real intelligence as possible, she kept vast numbers of spies all over the kingdom, who constantly gave her notice of what happened in their respective circles; and this she so cunningly improved to her own ends, that her subjects looked upon her as a kind of deity from whom nothing could be concealed.

34 Her influence over the Giagas.

By such means as these, Zingha gained such authority over the Giagas, that they were ready, at the very first indication of her will, to follow her through the most dreadful dangers, and to engage in the most desperate enterprizes. She now made many strenuous and daring efforts to drive out the Portuguese; but though she had, in all probability, more valour and skill than her enemies, the fire-arms gave them such an advantage, that she was always defeated with great loss. Perceiving therefore the folly of attempts of this kind, she contented herself with making continual inroads into their country, carrying off or destroying every thing that fell in her way. Though she spared nei-

35 Her terrible ravages.

ther Europeans, nor blacks who were subjects of the mock-monarchs set up by the Portuguese, yet the case of the former were peculiarly dreadful when they happened to be taken prisoners. They were either roasted

by

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by a slow fire, or had their flesh cut off in pieces, and devoured before their faces, in the manner related by Mr Bruce of the Abyssinian oxen *. In this manner she infested the Portuguese territories for 28 years, scarce ever allowing them a moment's cessation of arms. Their mock-kings were often obliged to shelter themselves from her fury in an inaccessible rock called *Maopongo;* and they themselves could never hope to enjoy their dominions with any kind of peace so long as this furious queen continued alive. They in vain exhausted all their politics either to reduce her by force, or to mollify her by presents and fair offers. The one she rejected with disdain, and always found means to baffle the other. Nor would she hearken to any terms, unless they consented to resign all their conquests. The refusal of this demand was so commonly followed by some marks of her resentment, that it was with the utmost difficulty the Portuguese could prevail on any body to carry their proposals to her; and as for Zingha she disdained to make any to them, except those of the hostile kind. The terror of her arms procured her a free passage wherever she directed her course; all the inhabitants of the province making no less haste to abandon, than she to invade it. Thus she continued to advance, till at length she was got so far as the small island of Dangii in the river Coanza. The Portuguese now found themselves under a necessity of raising an army of negroes, in order to drive her out of it. Accordingly they surrounded the island, and intrenched themselves along the banks on both sides of the river; but while they were busy at their work, Zingha attacked them with such advantage, that she killed and wounded several hundreds of the blacks, and some of the white men. Elated with this advantage, she was preparing for another attack; when she perceived, to her surprise, that the Portuguese had drawn their lines so close, and raised them to such a height, that they overlooked her whole camp, and could fire upon her naked soldiers as if they shot at a mark.—Thus great numbers of her men were cut off, particularly her chief officers. The queen, now perceiving the danger of her situation, amused the Portuguese with proposals of an accommodation; and having obtained a truce for three days, crossed the river in the dead of the night, and led her forces to the province of Oacco. The next morning, the Portuguese, seeing no human creature upon the island, began to apprehend some new stratagem; but, upon landing some of their troops, they perceived themselves over-reached, and deprived of the fairest opportunity they ever had of forcing her to surrender at discretion.

* See *Abyssinia*.

36 Outwits the Portuguese.

Zingha staid no longer in the province whither she had retired, than till she was assured that the Portuguese were retired from the Coanza; and then, crossing that river once more marched directly towards the kingdom of Metamba, which had been invaded by some of the neighbouring princes. The speed with which she led her forces thither, and recruited her army with multitudes of Giagas, who were all emulous of fighting under her banners, quickly enabled her to recover some of her territories in that kingdom. Beginning now to think herself successful, she again attacked the Portuguese; but was defeated with great loss, so as to be obliged to send for fresh troops. To complete her misfortune, she received news that the Giaga Cassangi had taken the advantage of her absence, to enter the kingdom of Metamba with a numerous army, had carried off the greatest part of the inhabitants, destroyed all the fruits of the earth, plundered the towns of all that was valuable, and set fire to the rest, leaving that kingdom in a manner desolate. To add to all this, her troops, exasperated at the loss of their wives, children, and goods, which were carried to the farthest corner of Benguela, were all on the point of revolting.

37 Her complicated misfortunes

Notwithstanding these disasters, Zingha behaved with such resolution and address, that the Portuguese, who, according to character, had probably instigated the Giaga against her, were so much afraid of her joing with him in alliance against them, that they dispatched one Anthony Coglio, a learned priest, and an excellent negociator, with Don Gaspar Borgia, an eminent officer, under pretence of negociating a peace between them, first to the Giaga, and afterwards to the queen. They met with a very civil reception from the first, who told them he was very willing to live at peace with that princess, and even to let her enjoy the kingdom of Metamba, though he was the rightful heir to it, provided she would lay down her arms. This answer encouraged the priest to try whether he could prevail on him to embrace the Christian religion; but this was declined by the Giaga in such strong terms, that the priest thought proper to desist, and set out for Zingha's camp. 38

38 The Portuguese send an embassy to her

The ambassadors, at their first arrival, met with such a polite reception, as made them hope for success: but after she had heard their proposals, she assumed a haughty threatening tone; and told them, in the conclusion of her speech, "That it did not become her dignity to lay down her arms, till she had brought the war she had begun, to an honourable conclusion: that as to the Giagas, whose sect she had embraced some years before, and who had furnished her with such a prodigious number of forces to fight in her defence, her honour and interest required that she should still keep them in her service, and under her protection: and lastly, that as to herself, she remembered, indeed, that she had formerly embraced Christianity; but that it was not now a proper season to propose her returning to it, and they ought to remember that they themselves were the cause of her abandoning it." 39

39 Their proposals rejected.

Borgia, perceiving that she was not to be wrought upon by religious motives, shifted the topic; and told her, that she had gained honour enough in war, and that it was now high time to think of granting peace and tranquillity to the subjects of two such powerful kingdoms, and accept of the favour and friendship of the king of Portugal. which was offered her by his viceroy. To this the queen made answer, that she was perfectly well acquainted with the valour and strength of the Portuguese, and should esteem it an honour to be allied to that monarch; but that she thought it just that their respective claims to the dominions which she justly inherited from her ancestors, and of which he had unjustly deprived her, should first of all be decided, either by the sword or by some equitable judges.

Borgia, vainly imagining that he had now obtained enough, set off immediately for Loanda San Paulo; but left the priest, on some pretence or other, to see whether, in the time of sickness, he could make any im-

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impreſſion on the inflexible mind of Zingha, who now laboured under a lingering diſeaſe. Coglio, however, found all his arts to no purpoſe; and, upon the queen's recovery, ſhe recommenced the war with more fury than ever.

40 Zingha's narrow eſcape.

For ſome time hoſtilities were carried on with various ſucceſs; Zingha being ſometimes victorious and ſometimes defeated. In one attempt of the latter kind, before the fortreſs of Maſſangana, ſhe not only loſt a great number of men, but had her two ſiſters Cambi and Fungi taken priſoners, ſhe herſelf eſcaping with the utmoſt difficulty. Exaſperated by this loſs, ſhe led her troops into ſome of the beſt provinces of the Portugueſe, and reduced them to a mere wilderneſs. Still, however, ſhe had the mortification to find her loſſes vaſtly greater than what ſhe gained; and had now the additional misfortune of loſing her ſiſter Fungi, who was put to death by the Portugueſe for treachery, and ſeeing her allies the Dutch totally expelled out of Angola.

41 Begins to relent;

Zingha being thus oppreſſed with a complication of misfortunes, and conſcious of the crimes ſhe had committed, began ſeriouſly to conſider whether ſuch a continued ſeries of diſaſters was not owing to the diſpleaſure of the God of the Chriſtians. To this opinion ſhe ſeemed to have inclined; and therefore began to treat with more lenity ſuch Chriſtians as fell into her hands, eſpecially if they happened to be prieſts or monks. To theſe ſhe now began to liſten with ſome attention; and ordered them, under ſevere penalties, to be treated with all poſſible reſpect; yet without loſing in the leaſt that invincible hatred ſhe had conceived againſt thoſe who had ſtripped her of her dominions, or dropping her reſolution never to make peace till ſhe had recovered them.

The viceroy, Don Salvador Correa, who had driven out the Dutch, being appriſed of the regard ſhown to the clergy by Queen Zingha, thought proper to ſend ſome capuchins to her, in hopes that they might now find her more tractable. But Zingha was ſtill proof againſt their utmoſt art; obſerving, however, that if they would conſent to reſtore what they had unjuſtly taken from her, ſhe would not only return to the Chriſtian religion, but encourage it to the utmoſt of her power.

42 But ſtill reſiſts the artifices of the Portugueſe

The viceroy, being now afraid that Zingha might make an alliance againſt him with the king of Congo, firſt raiſed a powerful army, and then acquainted that monarch, that, if he deſigned to prevent the total ruin of his dominions, he muſt immediately make reparation for all the damage he had cauſed to the Portugueſe by his alliance with the Dutch. The fame of the Portugueſe valour ſo intimidated the king, that he ſubmitted to a treaty almoſt on the viceroy's own terms; and as ſoon as this treaty was concluded, Don Ruy Pegado, an old experienced officer, was diſpatched to Zingha, offering a firm and laſting alliance with her, provided ſhe renounced the Giagan ſect, and returned to the boſom of the church. To this embaſſy ſhe returned the old anſwer, namely, that the Portugueſe themſelves had been the occaſion of all that had happened; as they had not only ſtripped her of her hereditary dominions, but dared to proclaim one of her vaſſals king of Angola; but, provided theſe dominions were reſtored, ſhe would immediately embrace Chriſtianity.

All this time the furious Queen Zingha went on with her ravages, notwithſtanding the viceroy kept plying her with letters for near three years. At laſt he had recourſe to the artifice of taking advantage of the remorſe for her crimes with which Zingha was ſometimes affected, in order to procure the peaceable enjoyment of his own ill-gotten conqueſts.

Angola. 43 Their infamous conduct.

It is eaſy to ſee, that had this viceroy, or the prieſts he employed, really intended to convert Zingha to Chriſtianity, they ought to have ſo far ſet her an example as at leaſt to abandon part of the countries of which they had robbed her: But, inſtead of this, they impiouſly made uſe of the ſacred name of our Saviour, in order to deter a poor ſavage African from recovering what juſtly belonged to her.

Queen Zingha, at laſt, came to incline ſo much to return to the Chriſtian religion, that a general murmur ran through her army. But having, by various artifices reconciled the minds of her ſubjects to this event, ſhe explained her deſign in a ſet ſpeech; offering at the ſame time liberty to thoſe who choſe to abandon her on this account to go where they would; and ſuch was their attachment to her, that even in ſuch a ſudden and important change in her reſolutions they expreſſed no uneaſineſs, but on the contrary applauded her to the higheſt degree. 44 She returns to Chriſtianity.

The Portugueſe, after having been harraſſed in a terrible manner for 28 years, and at laſt obliged to profane the name of their Saviour to procure a peace, began now freely to enjoy the fruits of their villany. A treaty was ſet on foot between the viceroy and Zingha; which, however, was not eaſily concluded. She demanded the releaſe of her ſiſter Cambi, whoſe Chriſtian name was Donna Barbara; and the Portugueſe demanded a ranſom of 200 ſlaves, or an equivalent in money. This Zingha did not well reliſh; and, being preſſed to a compliance, threatened them with a more furious war than any they had yet experienced. Upon this the viceroy was obliged to have recourſe to the uſual method of ſending prieſts to perſuade her to comply through motives of religion. Theſe hypocrites effected their purpoſe; and the ſlaves were ſent, as if Chriſtianity required the delivering up innocent people to thoſe who had no lawful authority over them: but not being able to conclude a laſting peace about the ceſſion of the Angolic provinces, they were forced to conclude a ſhort truce, and ſent back her ſiſter. 45 Treaty with the Portugueſe propoſed.

This princeſs was received by Zingha in a very affectionate manner: and ſome time after, the queen, her mind being probably weakened through the infirmity of old age, not only was thoroughly reconciled to the Portugueſe, but looking upon them as her beſt friends. She encouraged the Chriſtian religion; had a church built in her capital; made ſeveral laws againſt Paganiſm; and, *to encourage marriage*, ſhe herſelf wedded a handſome young fellow in the 75th year of her age.

The Portugueſe now imagining they would at laſt gain their point, propoſed to her the following terms, as the baſis of a laſting treaty between the two nations. 1. "That they ſhould yield to her, *as a preſent*, ſome of the countries of which they had already robbed her. 2. That, in conſideration of the ſaid preſent, which ſhould in noways be interpreted as an inveſtiture, the queen ſhould pay yearly a certain acknowledgment to the 46 The Portugueſe terms.

the king of Portugal, who ſhould be at liberty to withdraw the ſaid preſent whenever ſhe failed of making the ſaid acknowledgment. 3. That a free commerce ſhould be opened between thoſe two ſtates, as well for ſlaves as for other merchandizes. 4. That the queen ſhould moleſt none of the lords that were feudatory to the Portugueſe, whatever damages and ravages they might have committed during the late wars between them. 5. That ſhe ſhould reſtore all the Portugueſe ſlaves that had taken refuge in her dominions. 6. That ſhe ſhould deliver up the Giaga Colanda, who had revolted from the Portugueſe, upon condition that his crime ſhould go unpuniſhed."

The queen, having now a thorough view of the deep-rooted villany of thoſe with whom ſhe had to do, conceived ſuch diſpleaſure againſt the Portugueſe, that ſhe fell ſick. During this ſickneſs, father Anthony, her chief confident, and a creature of the viceroy, never left off ſoliciting her to make her peace with God, and to accept of the terms offered her by the Portugueſe: but Zingha, though worn out with age and ſickneſs, had ſtill the good ſenſe to perceive, that there was no connection between making her peace with God and complying with ſuch infamous terms; and therefore gave the following anſwer, which, under ſuch circumſtances, ſhows a magnanimity ſcarce equalled in any
47 The Queen's noble anſwer.
age or in any country. 1. "That as to her converſion, as it was neither owing to any deſire of obtaining a peace, or other worldly motives, but the Divine Grace by which ſhe was recalled, ſhe was reſolved to perſevere in it to her laſt breath. 2. That as to her going over to the Giagan ſect, ſhe had in a great meaſure been forced to it by the Portugueſe viceroy. 3. That the king of Portugal would do a generous act in reſtoring ſome of her Angolic dominions; but it would be more ſo, were he to reſtore them all. 4. That as to her paying homage to him, neither her mind nor heart were baſe enough to conſent to it; and that as ſhe had refuſed the propoſal while ſhe lived among the Giagas, much more did ſhe think herſelf above it now ſhe was a Chriſtian queen, and owed neither tribute nor homage to any but to the Supreme Power, from whom ſhe had received both her being and her kingdom: That, nevertheleſs, if ſhe could be convinced that there was any thing in her dominions that would be acceptable to his Portugueſe majeſty, ſhe would voluntarily make him a preſent of it; and as to the reſt of the articles, ſuch was her deſire of making a firm and laſting peace with them, that ſhe ſhould make no difficulty of conſenting to them."

This anſwer was not altogether ſatisfactory to the viceroy; but the prieſt, finding it impoſſible to make
48 Articles of the treaty.
any impreſſion upon her mind, eaſily prevailed upon him to conſent to the following terms. 1. "That the river Lucalla ſhould be the boundary between the dominions of the Portugueſe and of Queen Zingha. 2. That neither ſide ſhould thenceforth give any reception to the fugitive ſlaves of the other, but ſend them back without any delay, together with the priſoners which had been taken during the laſt war. 3. That the queen ſhould remain wholly free and exempt from all tribute and homage whatever, provided ſhe agreed to the other articles."

49 The peace ſigned.
Theſe terms were at laſt ſigned by the queen and viceroy in the month of April 1657, and ratified by the king of Portugal in the month of November the ſame year.—The only difficulty the queen had concerning this treaty was with regard to the Giaga Colanda: and the manner in which ſhe extricated herſelf from it, with her ſubſequent behaviour, cannot fail to give us an high idea of the mental abilities of this African heroine.

50 Zingha's honourable behaviour.
This Giagan chief, weary of the Portugueſe yoke, had retired from them, at the head of 1000 ſtout ſoldiers, and a much greater number of ſlaves, ſome leagues beyond the river Lucalla, and put himſelf under the queen's protection. This ſhe readily granted, as he was very able to be ſerviceable to her in caſe the perfidious conduct of the Portugueſe ſhould oblige her to renew the war. She could not therefore but look upon it as unjuſt and diſhonourable, to deliver up a brave chief who had devoted himſelf to her ſervice, and whom ſhe had taken under her ſpecial protection, to a nation with whoſe perfidy ſhe was ſo well acquainted. To ſave her honour, therefore, ſome time before the ratification of the treaty, ſhe ſent privately for the Giaga, and acquainted him with the demand of the Portugueſe; telling him, at the ſame time, that though ſhe doubted not of the viceroy's keeping his word, and forgiving his offence, yet ſhe adviſed him to go out of her dominions, and ſettle himſelf and his men in ſome diſtant country from the Portugueſe frontiers; but forbad him, on pain of her higheſt diſpleaſure, to commit the leaſt outrage or hoſtility within their dominions.

The Giaga thanked her majeſty, and ſeemed to acquieſce with her advice, but did not follow it. On the contrary, he had no ſooner reached his fortreſs, than he ſet himſelf about fortifying it in ſuch a manner as looked rather like defiance than defence; and, having gathered a conſiderable army, ſoon ſpread a general terror around him. Of this the Portugueſe failed not to complain to the queen; who immediately marched
51 Defeats and kills the Giaga Colanda.
againſt him, ſurpriſed and defeated his army; and he himſelf being killed in the action, his head was cut off and ſent to the Portugueſe.

This was among the laſt memorable actions performed by this famous queen; who, now finding herſelf unfit for the fatigues of war, contented herſelf (in 1658) with diſpatching an old experienced general againſt a neighbouring prince who had invaded her territories. He proved no leſs ſucceſsful than herſelf, and quickly
52 Encourages Chriſtianity.
forced the aggreſſor to ſubmit to her terms. She now gave herſelf up to ſtudy the beſt method of propagating Chriſtianity among her ſubjects; and for this purpoſe ſent a ſolemn embaſſy to Rome, to pay homage to the Pope in her name, and to requeſt a freſh ſupply of miſſionaries. To this letter ſhe received an anſwer from his Holineſs in 1662; and it was read in the church, that ſame year, in the moſt public and ſolemn manner. The day appointed was the 15th of July; on which ſhe repaired to the church at the head of a numerous retinue, and having the letter hanging about her neck in a purſe made of cloth of gold. The concourſe was ſo great, that the church could not contain one half of the people, ſo that none were admitted but perſons of rank. The father having finiſhed the maſs, read the letter at the altar in the Portugueſe language; and the ſecretary interpreted it in that of the country. The queen, who had ſtood all the while it was reading, went towards the

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53 Ceremonies at receiving a letter from the Pope.

the altar, and on her knees received it from the father: and having kiſſed it, and ſworn afreſh upon the goſpel to continue in obedience to the church of Rome, kiſſed the letter again, put it into the purſe, and returned to the palace amidſt the ſhouts and acclamations of many thouſands of her ſubjects. On that day ſhe gave a magnificent treat to the Portugueſe reſident, and to all her court, in two great porticos, and ſhe herſelf vouchſafed to eat after the European manner; that is, ſitting on a ſtately elbow chair, with a high table before her, covered with the fineſt linen, and with diſhes, plates, knives, and forks, all of ſilver gilt. She beſtowed ſome largeſſes upon her chief officers, releaſed a good number of ſlaves, and at night appeared at the head of her ladies of honour, both ſhe and they dreſſed in the Amazonian manner. They performed a kind of combat, in which the queen, though upwards of eighty years of age, behaved with the great vigour and activity of a woman of thirty.

54 Zingha dies.

Her life, however, was not lengthened in proportion to her vigour and activity: for in the month of September ſhe was ſeized with an inflammation in her throat; which, in December, having ſeized her breaſt and lungs, ſhe expired on the 7th of that month, and was ſucceeded by her ſiſter Barbara.

55 Succeeded by her ſiſter Barbara.

The deceaſed queen was buried with extraordinary pomp; and, out of regard to her, Barbara was inaugurated a ſecond and third time, with the greateſt pomp, and the moſt joyful acclamations.—She was a very zealous chriſtian, but wanted her ſiſter's abilities, and had the misfortune to be in the decline of life, lame, and almoſt blind. Beſides this, ſhe had been married to a proud ill-natured huſband, named Mona Zingha; who, though to her he owed all his fortune and advancement, being himſelf no more than the ſon of a ſlave, uſed her with ſuch cruelty, even in the late queen's life, that ſhe was obliged to take refuge in the palace, from whence he had the inſolence immediately to fetch her. This ſo exaſperated queen Zingha, that ſhe had well nigh ordered him to be cut in pieces before her face; but pardoned him at the requeſt of father Anthony, who probably knew he was privy to ſome religious ſecrets, which he might, in a caſe of ſuch emergency, have diſcloſed. On Barbara's acceſſion to the throne, however, he not only redoubled his cruelty to her, in hopes of getting the management of affairs entirely into his own hands, but invented accuſations againſt Anthony himſelf, with a deſign to extirpate both him and his religion. He gave out that the late queen had been poiſoned by ſome favourite European diſhes, with which brother Ignatio uſed to regale her during her laſt illneſs; and attributed his wife's lameneſs and blindneſs to ſome ſorceries or charms uſed by the convent againſt her. He had even perſuaded, or rather forced, his queen to conſent that ſome of the ſinghillos or prieſts ſhould be brought to countercharm her diſtemper.

56 Cruelty of her huſband Mona Zingha to her.

57 He accuſes Father Anthony.

58 Who reprimands the queen.

Father Anthony, far from being intimidated at the accuſations brought againſt him, repaired immediately to the palace; where he boldly reprimanded the queen for giving ear to theſe jugglers, threatening at the ſame time to leave her dominions, and carry off with him all the croſſes and other religious utenſils, from which alone they could have any benefit. The queen returned a very ſubmiſſive anſwer; and promiſed to deliver up the counter-charms which ſhe at that time had upon her, before ſunſet; which ſhe accordingly did, and ſent them to the convent by the hands of her ſecretary. This ſo exaſperated her huſband, and all the Giaga ſect, that they reſolved upon the deſtruction of all the prieſts and Europeans, and even the queen herſelf. This, however, was found improper to be attempted; and Mona Zingha was ſo much chagrined at his diſappointment, that he retired to his own eſtate; giving out, that he deſigned no more to meddle with ſtate-affairs; but, in reality, to concert meaſures for engroſſing the ſovereignty to himſelf, and to deprive his wife of her life and crown.

Angola.

To accompliſh his purpoſe, he ſent a meſſenger to her, deſiring her to repair to his houſe, where he had ſomething of importance to communicate; but ſhe declining the invitation by the advice of father Anthony, he found himſelf diſappointed, and begged leave to retire to a neighbouring province, which was under his government. He was again diſappointed, and forbid to ſtir out of the province of Metamba. The queen was, however, guilty of an error not long after, in ſending Mona Zingha at the head of an army to quell a revolt on the frontiers. On his returning victorious, he thought himſelf ſtrong enough to revive the ancient Giagan rites, and therefore ordered 100 ſlaves to be ſacrificed to the manes of the deceaſed queen. Though the queen was immediately appriſed of his intention, and diſpatched a meſſenger expreſsly commanding him to deſiſt; yet Mona, by diſtributing ſome preſents, particularly ſome European wines among the counſellors, effected his purpoſe with impunity. He did not forget to ſend ſome of his wine to father Anthony: but to prevent ſuſpicion, preſented him only with a ſmall quantity, to be uſed, as he ſaid, at the maſs; adding, that if it proved agreeable, he would ſupply him with a larger quantity. The unſuſpecting prieſt drank about two glaſſes of it; and in about a quarter of an hour was ſeized with violent convulſions in his bowels, and other ſymptoms of being poiſoned. By proper aſſiſtance, however he recovered; yet ſo far was he diſabled by this doſe, that he was obliged to abandon his miſſion.

59 Mona Zingha revives the Gigan rites;

60 And poiſons Father Anthony,

The queen's infirmities in the mean time daily increaſing, Mona Zingha was ſoon delivered from all further oppoſition on her part, by her death, which happened on the 24th of March 1666. Upon this, Mona Zingha made all poſſible haſte to get himſelf elected king; and immediately renounced the Chriſtian religion, raiſing a perſecution at the ſame time againſt its profeſſors. He even wrote to the Portugueſe viceroy, acquainting him with his having renounced Chriſtianity, which he had only embraced out of complaiſance to his queen, and with his deſign to revive the Giagan rites. To ſhow that he meant to be as good as his word, he ordered all the children under ſix years of age, that could be found, to be ſacrificed in honour of their infernal deities. He alſo recalled the ſinghillos, and heaped many favours upon them; ſo that they became entirely devoted to his purpoſes. He likewiſe cauſed many of his ſubjects to be privately poiſoned; and then gave out, that their unaccountable deaths were owing to their having abandoned the religion of their anceſtors, and embraced Chriſtianity; which he ſtyled the religion of a parcel of famiſhed ſtrangers, who through their extreme miſery, had been forced to leave their native country,

61 The Queen dies.

62 Cruelties of Mona Zingha.

Angola. try and seek for a livelihood in the richest provinces of Africa.

By these and such like stratagems he almost entirely extirpated Christianity, and any appearances of civilization which had been introduced among his subjects. His career, however, was stopped by Don John the princess Barbara's first husband, from whom she had been divorced on account of his having another wife. He soon compelled the usurper to fly into an island in the Coanza; but not having the precaution to reduce him entirely, Mona Zingha found means to retrieve his affairs, and at last found means to kill Don John himself, by which he became master of the throne without any further opposition. He was no sooner re-established, than he began to pursue his butcheries with more fury than ever: when, on a sudden, Don Francisco, the son of Don John, appeared at the head of an army in opposition to the usurper; and in the first engagement Mona Zingha being defeated and killed, Don Francisco became sole master of the empire.

63 He is defeated and killed.

It is not known whether this prince kept to the terms of the alliance made by Queen Zingha with the Portuguese or not.—These, however, have preserved their conquests, and for some time they allowed the natives to choose a king for themselves, or rather they chose him for them, as we have already noticed. These kings enjoyed only a mere shadow of royalty; their whole grandeur consisting in being allowed to breed peacocks, and adorn themselves with their feathers, which was forbidden to their subjects under pain of perpetual slavery. The last of these kings was named Ngola Sedesio, who, disliking an empty name of royalty, revolted from the Portuguese, and carried on a long war with them; but being at last defeated and killed, his head was cut off, salted, and sent to Lisbon in pickle. After this the Portuguese seem not to have thought it safe to trust their Angolic subjects even with the name of a king of their own, but have vested the power entirely in their viceroy; but as to the extent of his dominions, and how matters stand between him and that race of Angolic princes who have preserved their liberty, we are entirely in the dark.

64 Low state of the kings set up by the Portuguese

Division into provinces.

When in its greatest splendor, the kingdom of Angola contained the 17 following provinces: Chessama, Sumbi, Benguela, Rimba, Sietta, High and Low Bembea, Temba, Oacco, Cabezzo, Lubolo, Loanda, Bengo, Danda, Mosiche, Higher and Lower Ilamba, Oraij, and Embacca,. The provinces conquered by the Portuguese during the wars abovementioned were, Danda, Mosiche, Bengo, the Higher and Lower Ilamba, Oraij, Embacca, Benguela, Sietta, Cabezzo, Lubolo, and Oacco.

Rivers.

The principal rivers are those already mentioned, viz. The Danda and Coanza. The Coanza is large, deep, and rapid. It empties itself into the Atlantic ocean about Latitude 9° 20' S. twelve leagues south of Loando the capital of the kingdom. It is navigable for 150 miles, and abounds with variety of fish. It forms several islands, has some cataracts,, and one in particular which bears its name. As for its source, and the length of ground it crosses from east to west before it comes to the Portuguese settlement, it is absolutely unknown, as well as the countries through which it runs. Its mouth, which runs between the capes Palmerino and Lego, is above a league wide; the northern shore is the deepest, and along which the vessels sail. The fall of this river into the ocean is so rapid, that the sea appears quite muddy for two or three leagues below it. Its mouth is not easily perceived from the open sea, by reason of an island quite covered with high trees which lies just before it. The two principal islands formed by this river are called *Massander* and *Motchiamia*. The one is six leagues long, and about two miles broad: it is very fertile in maize, millet, and some other grains, which are reaped at three different seasons of the year. It produces likewise vast quantities of Manhioc, a root, of which they make a coarse kind of meal, which serves instead of bread. Here also grow great numbers of palm and other fruit trees of various kinds. The island of Motchiamia is four or five miles long, and one in breadth, mostly plain, and producing variety of roots and herbs. It likewise abounds in cattle; and there were formerly five or six Portuguese families settled upon it, who drove a considerable trade in these commodities, and likewise in slaves.

Angola ‖ Angoumois.

Concerning the river Danda we know little or nothing: only, that though its mouth is not above 70 or 80 miles distant from that of the Coanza, yet their distance grows so considerably wider as you penetrate further into the inlands, as to be much above twice if not thrice that space; though how much, is not exactly known.

The manners, religion, and dress, &c. of the inhabitants, are much the same with the Congoese. See CONGO.

ANGOLA Pea, or *Pigeon-Pea*. See CYTISUS.

ANGON, in the ancient military art, a kind of javelin used by the French. They darted it at a considerable distance. The iron head of this weapon resembled a flower-de-luce. It is the opinion of some writers, that the arms of France are not flowers-de-luce, but the iron point of the angon or javelin of the ancient French.

ANGOR, among ancient physicians, a concentration of the natural heat; the consequence of which is a pain of the head, palpitation, and sadness.

ANGOT, a province or kingdom of Abyssinia, formerly rich and fertile, but almost ruined by the Gallas, a wandering nation in the internal parts of Africa, who dispossessed the Abyssinian monarchs of all that was worth possessing.

ANGOULESME, a city of France, the capital of the duchy of Angoumois, and see of a bishop. It is seated on the top of a hill, surrounded with rocks, at the foot of which runs the river Charante. The inhabitants are said to be about 8000, and to drive a considerable trade in paper, which is their manufacture. E. L. 0. 10. N. Lat. 45. 39.

ANGOUMOIS, a province of France, bounded on the north by Poitou, on the east by Limousin, and March, on the south by Perigord, and on the west by Saintonge. Through this province run the rivers Touvre and Charante. This last is full of excellent fish; and though it often overflows its banks, it is so far from doing any damage, that it greatly enriches the soil. The Touvre is full of trouts. The air is generally warmer than at Paris, though the country is hilly. The

soil

soil produces plenty of wheat, rye, oats, Spanish corn, saffron, grapes, and all sorts of fruit. Here are several iron mines, which yield a very good sort of iron.

ANGOURA, Angra, or Angori, a city of Asia, in Anatolia, formerly called *Ancyra*, and still full of remarkable antiquities, which are so many marks of its ancient magnificence. It is at present one of the best cities in Anatolia; its streets are full of pillars and old marbles, among which are some of porphyry and jasper. The greater part of the pillars are smooth and cylindrical; some are channelled spirally; but the most singular are oval, with plate bands before and behind from the top to the bottom of the pedestal. The houses are now made of clay, which is sometimes intermixed with fine pieces of marble. The walls of the city are low, with very mean battlements. The masonry of the walls is intermixed with pillars, architraves, capitals, and other ancient fragments, especially that of the towers and gates. The castle of Angora has a triple inclosure; and the walls are of large pieces of white marble, and a stone much like porphyry.

The basha of Angora has about 30 purses income; and there are here about 300 janisaries, under the command of a sardar. The Turks are said to be 40,000, the Armenians 4000 or 5000, and the Greeks 600. The Armenians have seven churches, besides a monastery; and the Greeks two. They breed the finest goats in the world; and their hair which is of a dazzling white, is almost as fine as silk, and nine inches in length: it is worked into very fine stuffs, particularly camblet. All the inhabitants are employed in this manufacture. Several large caravans pass through this city to different places. E. Long. 32. 5. N. Lat. 39. 30. See Ancyra.

ANGOY, a kingdom of Loango in Africa, bounded on the north by Cacongo, and on the south by Congo; from the former of which it is separated by the river Cabinda, and from the latter by the river Zaire. It is but of small extent; being only a vassal province of Cacongo, till the mani or prince, who had married a Portuguese's daughter, was persuaded by his father-in-law to make himself independent. This he effected at a favourable juncture, the king of Loango having but just before revolted from the king of Congo, and the king of Cacongo from the new king of Loango. The country is full of woods and thickets; and has no towns of any note, except one called Bomangoy, situated on the north banks of the Zaire, and not far from its mouth. Its chief port is Cubinda, called also Kabenda, or Cubenda, situated on the mouth of a river of the same name about five leagues north of Cape Palmerino, on the north side of the Zaire's mouth. The bay is very commodious for trade, or wooding and watering along the shore. It is flat and marshy in some places; but ascends gradually about three miles inland, and then forms itself into a ridge of hill. On the ascent of these is situated a town belonging to the father-in-law of the king above mentioned, where he constantly kept a stock of wood ready cut, to sell to foreign ships at an easy rate. From these wood-piles, south-west along the bay, lie scattered a number of fishermen's huts, on each side a small fresh water river which falls into the bay; and thence all the water for ships is brought in casks to the mouth of the river, which is so shallow, that even at full flood it can only be entered by a yawl carrying a cask or two. The town stands on the round point of the bay looking to the westward; and the English have a factory on the south-west of the road.

The country round the bay is mostly barren; owing chiefly to the laziness of the inhabitants, which often occasions a scarcity of provisions. The wild beasts swarm so in the woods, that they destroy all the tame kinds; so there are no cattle bred here but hogs. From the woods in this county some monkeys have been brought away, which in shape and stature resembled the human species. Civet-cats abound here in great plenty, and parrots may be bought for three or four ordinary knives. The coasts abound so with oysters, that the sailors quickly load their boats with them; they being found lying in great heaps like small rocks. The natives follow the occupation of fishing more than any other. They fish both on the sea and in the rivers, making use of drag-nets, which have long canes fixed at equal distances, instead of corks, to show when any fish is caught. These nets are made of a peculiar kind of root, which, after being beaten, may be spun like hemp.

The dress of the inhabitants is the same with that of the Congoese. They allow polygamy, and the best beloved wife hath the command of the rest; but is no less liable to be turned out, if she proves unfaithful. The ladies of the blood-royal have the privilege of choosing their husbands out of any, even the meanest rank; and even the power of life and death over them; as likewise over their paramours, if any of them are caught tripping: but the husbands are by no means entitled to expect the same fidelity from their royal ladies. Women of the lower rank are obliged, when they receive a stranger, to admit them for a night or two into their embraces. This obliged the missionaries, who travelled through this country, to give notice of their approach to any of their houses, that none of the female sex might enter within their doors.—Their religion consists chiefly in a variety of superstitious customs; such as powdering their public and domestic idols with the dust of a kind of red wood, on the first day of the moon, and paying a kind of worship to that planet. If, on that night, it happens to shine clear and bright, they cry out, "Thus may I renew my life as thou dost;" but if the air is cloudy, they imagine the moon hath lost her virtue, and pay her no respect. We do not hear of their offering any sacrifices to their idols; though they commonly consult them about the success of their enterprises, thefts, or such like. The king of Congo still styles himself sovereign of Angoy; but the king of this little state pays neither tribute nor homage to any foreign power.

ANGRA, a city of Tercera one of the Azores; the capital, not only of that island, but of all the rest, and the residence of the governor. It is seated on the south side, near the middle of the longest diameter of the island, on the edge of the sea. The harbour is the only tolerable one in the whole island, being equally secured against storms and the efforts of an enemy. It is of the form of a crescent; the extremes of which are defended by two high rocks, that run so far into the sea as to render the entrance narrow, and easily covered by the batteries on each side. From this harbour the town is said to be derive its name, the word *Angra* ſignifying a creek, bay, or ſtation for ſhipping; and this is the only convenient one among all the Azores. The opening of the port is from the eaſt to the ſouth-weſt; and, according to Frezier, it is not above four cables-length in breadth, and not two of good bottom. Here ſhips may ride in great ſafety during the ſummer; but as ſoon as the winter begins, the ſtorms are ſo furious, that the only ſafety for ſhipping is the putting to ſea with all poſſible expedition. Happily, however, theſe ſtorms are preceded by infallible ſigns, with which experience has made the inhabitants perfectly well acquainted. On theſe occaſions the Pico, a high mountain in another of Azores, is overcaſt with thick clouds, and grows exceedingly dark; but what they look upon as the moſt certain ſign is the fluttering and chirping of flocks of birds round the city for ſome days before the ſtorm begins.

The town is well-built and populous, is the ſee of a biſhop, under the juriſdiction of the archbiſhop of Liſbon. It hath five pariſhes, a cathedral, four monaſteries, as many nunneries, beſides an inquiſition and biſhop's court, which extends its juriſdiction over all the Azores, Flores, and Corvo. It is ſurrounded by a good wall, a dry ditch of great depth and breadth, and defended by a ſtrong caſtle rendered famous by the impriſonment of king Alphonſo by his brother Peter in 1668. Though moſt of the public and private buildings have a good appearance externally, they are but indifferently furniſhed within; but for this poverty the Portugueſe excuſe themſelves, by ſaying, that too much furniture would prove inconvenient in ſo warm a climate.

At Angra are kept the royal magazines for anchors, cables, ſails, and other ſtores for the royal navy, or occaſionally for merchantmen in great diſtreſs. All maritime affairs are under the inſpection of an officer called *Deſembergrador*, who hath ſubordinate officers and pilots for conducting ſhips into the harbour, or to proper watering-places. The Engliſh, French, and Dutch, have each a conſul reſiding here, though the commerce of any of theſe nations with the Azores is very inconſiderable.

ANGRIVARII, (Tacitus); a people of Germany, ſituated between the Weſer and the Ems, and eaſtward reaching beyond the Weſer, as far as the Cheruſci, on which ſide they raiſed a rampart (Tacitus); to the ſouth, having the Tubantes on the Ems, and on the Weſer where it bends to the foreſt Bacemis; to the weſt, the Ems and the confines of the Bructeri; and to the north, the territory of the Angrivarii lay between the Chamavi and Anſibarii. Ptolemy places them between the Cauchi and Suevi or Catti. Suppoſed now to contain a part of the country of Schaumburg, the half of the biſhopric or principality of Minden: to the ſouth, the greateſt part of the biſhopric of Oſnabrug, the north part of the country of Teclenburg, and a part of the country of Ravenſberg. A trace of the name of the people ſtill remains in the appellation *Engern*, a ſmall town in the county of Ravenſberg.

ANGUILLA, one of the Weſt-India or Carribbee iſlands, lying in about 15° N. Lat. It has its name from its ſnake-like form; and is about ten leagues in length and three in breadth. It was firſt diſcovered by the Engliſh in 1650, when it was filled with alligators and other noxious animals; but they, finding the ſoil fruitful, and proper for raiſing tobacco and corn, ſettled a colony on it, and imported live cattle, which have ſince multiplied exceedingly. But the colony not being ſettled under any public encouragement, each planter laboured for himſelf, and the iſland became a prey to every rapacious invader, which diſheartened the inhabitants ſo much that all induſtry was loſt among them. Their chief ſuffering was from a party of wild Iriſh, who landed here after the Revolution, and treated them worſe than any of the French pirates who had attacked them before. The people of Barbadoes, and other Engliſh Carribbees, knowing the value of the ſoil, ſeveral of them removed to Anguilla, where they remained for many years, and even carried on a profitable trade, though without any government either civil or eccleſiaſtical. In 1745, their militia, though not exceeding 100 men, defended a breaſtwork againſt 1000 French who came to attack them, and at laſt obliged them to retire with the loſs of 150 men, beſides carrying off ſome of their arms and colours as trophies of their victory. Since that time the inhabitants have ſubſiſted moſtly by farming; though they ſtill plant ſugar, and the iſland is ſaid to be capable of great improvements.

ANGUINA. See TRICOSANTHES.

ANGUILLIFORM, an appellation given by zoologiſts, not only to the different ſpecies of eels, but to other animals reſembling them in ſhape.

ANGUINUM OVUM, a fabulous kind of egg, ſaid to be produced by the ſaliva of a cluſter of ſerpents, and poſſeſſed of certain magical virtues. The ſuperſtition in reſpect to theſe was very prevalent among the ancient Britons, and there ſtill remains a ſtrong tradition of it in Wales. The account Pliny* gives of it is as follows: "Præterea eſt ovorum genus in magna "Galliarum fama, omiſſum Græcis. Angues innumeri "æſtate convoluti, ſalivis faucium corporumque ſpumis "artifici complexu glomerantur; anguinum appellatur. "Druidæ ſibilis id dicunt in ſublime jactari, ſagoque "oportere intercipi, ne tellurem attingat: profugere "raptorum equo: ſerpentes enim inſequi, donec arce-"antur amnis alicujus interventu."—Of which the following may ſerve as a tranſlation: (from *Maſon's Caractacus*; the perſon ſpeaking, a Druid.)

* Lib. xix. c. 3.

But tell me yet
From the grot of charms and ſpells,
Where the matron ſiſter dwells,
Brennus, has thy holy hand
Safely brought the Druid wand,
And the potent *Adder-ſtone*,
Gender'd 'fore the autumnal moon?
When, in undulating twine,
The foaming ſnakes prolific join;
When they hiſs, and when they bear
Their wond'rous egg aloof in air:
Thence before to earth it fall,
The *Druid* in his hallow'd pall,
Receives the prize,
And inſtant flies,
Follow'd by the envenom'd brood,
'Till he croſs the cryſtal flood.

This wondrous egg ſeems to be nothing more than a bead of glaſs, uſed by the Druids as a charm to impoſe on the vulgar, whom they taught to believe, that the poſſeſſor would be fortunate in all his attemps, and that it would gain him the favour of the great.

Our

Anguis.

Our modern Druideſſes (ſays Mr Pennant, from whom we extract) give much the ſame account of the *ovum anguinum, glain neidr*, as the Welſh call it, or the *adder-gem*, as the Roman philoſopher does; but ſeem not to have ſo exalted an opinion of its powers, uſing it only to aſſiſt children in cutting their teeth, or to cure the chincough, or to drive away an ague.

Theſe beads are of a very rich blue colour; ſome plain, others ſtreaked. For their figure, ſee Plate XXXIV. fig. 22. nº 1, 2, 3.

ANGUIS, or SNAKE, in zoology, a genus belonging to the order of amphibia ſerpentes. The characters of the anguis are theſe: They are ſqamous or ſcaly in the belly and under the tail; without any ſcuta.* There are 15 ſpecies of the anguis, viz. 1. The eryx, a native of Britain and likewiſe of America, is about a ſpan in length, and about the thickneſs of a man's finger. One from Aberdeenſhire, deſcribed by Mr Pennant, was 15 inches long; tongue broad and forked; noſtrils ſmall, round, and placed near the tip of the noſe; eyes lodged in oblong fiſſures above the angle of the mouth; belly of a bluiſh lead colour, marked with ſmall white ſpots irregularly diſpoſed: The reſt of the body of a greyiſh brown, with three longitudinal duſky lines; one extending from the head along the back to the point of the tail; the others broader, and extending the whole length of the ſides. It was entirely covered with ſmall ſcales; largeſt on the upper part of the head. 2. The fragilis, blind-worm, or ſlow-worm, grows to about a foot in length, and the thickneſs of a man's little finger: the irides are red; the head is ſmall; the neck ſtill more ſlender; from that part the body grows ſuddenly, and continues of an equal bulk to the tail, which ends quite blunt. The colour of the back is cinerous, marked with very ſmall lines compoſed of minute black ſpecks: the ſides are of a reddiſh caſt; the belly duſky; both marked like the back. The tongue is broad and forky; the teeth are minute, but numerous; the ſcales ſmall. The motion of this ſerpent is ſlow, from which, and from the ſmallneſs of the eyes, are derived its name. It reſembles the viper in the manner of producing its young, which are put forth alive. It frequents gardens and paſtures, where it lives principally under ground feeding on worms. Like others of the genus, they lie torpid during winter, and are ſometimes found in vaſt quantities twiſted together. 3. The ventralis, or glaſs-ſnake of Cateſby, has 127 ſquamæ on the belly, and 223 on the tail. The head is very ſmall, and the tongue of a ſingular form. The upper part of the body is of a colour blended brown and green, moſt regularly and elegantly ſpotted with yellow, the undermoſt part of which is brighteſt. The ſkin is very ſmooth; and ſhining with ſmall ſcales, more cloſely connected, and of a different ſtructure from thoſe of other ſerpents. A ſmall blow with a ſtick will cauſe the body to ſeparate, not only at the place ſtruck, but at two or three other places, the muſcles being articulated in a ſingular manner quite through to the vertebra. They appear earlier in the ſpring than any other ſerpent, and are numerous in the ſandy woods of Virginia and Carolina. They are generally ſaid to be harmleſs. 4. The jaculus, or dart-ſnake, is about three hand-breadths long, and about the thickneſs of one's little finger. Its colour is a milky grey on the back, variegated with ſmall black ſpots like ſo many eyes; and on the belly it is perfectly white. The neck is wholly black; and from that two milk-white ſtreaks run all the way along the back to the tail: the black ſpots alſo are each ſurrounded with a ſmall circle of white. It has its name from its vibrating its body in the manner of a dart. It is a native of Egypt, Libya, and the iſlands of the Mediterranean. 5. The quadrupes: The body of this ſpecies is cylindrical, with 14 or 15 longitudinal aſh-coloured ſtreaks; the teeth are extremely ſmall; it has no ears: the feet are at a great diſtance from each other, very ſhort, with five toes and ſmall nails; but the toes are ſo minute, that they can hardly be numbered: It is a native of Java. 6. The bipes, is a native of the Indies; it has two ſhort feet, with two toes, near the anus. In every ſcale of the bipes there is a brown point. 7. The meleagris, is likewiſe a native of the Indies; it has ſmall teeth, but no ears. This ſpecies has a great reſemblance to the former. 8. The colubrina, an inhabitant of Egypt, is beautifully variegated with pale and yellow colours. 9. The maculata, a native of America, is yellow, and interſperſed with aſh-coloured lines on the back: the head is ſmall in proportion to the body. 10. The reticulata, a native of America, has browniſh ſcales, with a white margin. 11. The ceraſtes, with 200 ſqamæ on the belly and 15 on the tail, is a native of Egypt. 12. The lumbricalis, a native of America, has 230 ſquamæ on the belly and 7 on the tail; its colour is a yellowiſh white. 13. The platura: The head is oblong and without teeth; the body is about a foot and a half long, black above and white below; the tail is about one-ninth of the length of the animal, much compreſſed or flatted, and variegated with black and white; the ſcales are roundiſh, ſmall, not imbricated, but they cannot be numbered. 14. The laticauda, a native of Surinam: the tail is compreſſed, acute, pale, with browniſh belts. 15. The ſcytale, a native of the Indies, with 220 ſquamæ on the belly and 13 on the tail. The head is ſmall and oval, and the eyes are little; the body is cylindrical, about a foot and a half long, covered with oval obtuſe ſcales: the tail is thick and obtuſe like the head; its colour is white, interſperſed with browniſh rings; the margins of the ſcales are of an iron colour; and the top of the head is blue.—According to Linnæus, none of this genus are poiſonous.

* See Plates XVII. and XXXI.

Anguis. Anguria.

ANGURIA, the WATER-MELON: A genus of the diandria order, belonging to the monœcia claſs of plants; and in the natural method ranking under the 34th order, *Cucurbitaceæ*. The eſſential characters are theſe: the *male* calyx is quinquefid, and the corolla quinquepetalous: The *female* calyx and corolla the ſame: The pericarpium is a pome beneath, with two cells: The ſeeds are numerous.

Species. Of this genus, Linnæus reckons three ſpecies, the trilobata, pedata, and trifoliata. The fruit is cultivated in Spain, Portugal, Italy, and other warm countries of Europe; as alſo in Africa, Aſia, and America; where it is eſteemed on account of its wholeſome cooling quality.

Culture. To have this fruit good, ſome ſeeds muſt be procured of three or four years old; new ſeeds being apt to produce vigorous plants, which are ſeldom ſo fruitful as thoſe of a moderate ſtrength. Theſe are to be ſown in the hot-bed for early cucumbers. Some new dung is to be prepared in the beginning of February, which ſhould be thrown into a heap to heat, as is practiſed for early cucumbers. The bed is then to be made in the ſame manner as for the muſk-melon, covering the dung about five inches thick with loamy earth; but as theſe plants require much more room than either cucumbers or common melons, there ſhould be but one plant put into a three-light frame. A hill of the ſame loamy earth ſhould therefore be raiſed a foot and a half high, in the middle light of each frame; into which, when the bed is of a proper temper for heat, the plants ſhould be carefully planted, obſerving to water and ſhade them until they have taken good root. As to other particulars, their management differs very little from that of the muſk-melon: only they muſt frequently have freſh air admitted to them; and, when the nights are cold, the glaſſes muſt be covered with mats to keep the beds warm.

ANGUS, a diſtrict of the country of FORFAR, in Scotland. It was an earldom belonging to the Douglaſes, now extinct.

ANGUSTICLAVIA, in Roman antiquity, a tunica embroidered with little purple ſtuds. It was worn by the Roman knights, as the laticlavia was by the ſenators.

ANHALT, an iſland of Denmark, in North Jutland, lying in the Categut, eight miles from the coaſt of Jutland, ten from Zealand, and ſeven from Holland. It is dangerous for ſeamen, for which reaſon there is a light-houſe.

ANHALT, a principality of Germany, in the circle of Upper Saxony, is a long narrow tract, ſituated for the moſt part betwixt the rivers Elbe and Saal, about 90 miles in length from eaſt to weſt, but of unequal breadth, the greateſt being on the eaſt ſide, which is but 35 miles. The houſe of Anhalt, from whence the electors of Saxony and Brandenburg are ſaid to derive their original, is a very ancient and honourable family. The beſt genealogiſts deduce their origin from Berenthobaldus, who made war upon the Thuringians in the ſixth century: it has produced many princes who make a great figure in the German hiſtory. Joachim Erneſt, who died in 1586, left five ſons, who divided the principality among them. All of them having children, and being of equal authority, they unanimouſly agreed to ſubmit to the eldeſt of the family, who has the ſupreme government, which is *Anhalt-Deſſau*. The others are, *Anhalt-Bernburg*, *Anhalt-Schaumburg*, *Anhalt-Coethen*, and *Anhalt-Zerbſt*. The Saxons acknowledge that the inhabitants of theſe little independent ſovereignties live in the land of milk and honey. Theſe petty princes poſſeſs lands ſufficient for their expences, the revenues being reckoned about half a million of dollars. The tax on lands is four *per cent.* which, rating them at 20 years purchaſe, is not quite one ſhilling in the pound. Upon an emergency the ſubjects are able to raiſe half a million extraordinary. The towns in theſe little ſtates are not ſo numerous in proportion to the extent of country as in Saxony, but better peopled. It is bounded on the S. by the country of Mansfield, on the W. by the duchy of Halberſtadt, on the E. by the duchy of Saxony, and on the N. by the duchy of Magdeburg. It abounds in corn, and is watered by the Salde and Mulda; its principal trade is in beer.

ANHELATIO, or ANHELITUS, among phyſicians, a ſhortneſs of breath.

ANIAN, the name of a ſtrait formerly ſuppoſed to lie between the north-eaſt of Aſia and the north-weſt of America; but now found to exiſt only in imagination.

ANIAN is alſo the name of a barren ſandy deſart lying on the eaſt coaſt of Africa. It is ſo exceſſively hot and otherwiſe inhoſpitable, that it contains but very few inhabitants, except ſome wandering Arabs who live in camps.

ANIELLO, or MASSANIELLO. See Hiſtory of NAPLES.

ANJENGO, a ſmall town and factory, with a fort, on the coaſt of Malabar, in the peninſula on this ſide the Ganges, belonging to the Engliſh Eaſt-India Company. The fort is ſmall, but neat and ſtrong; it is a ſquare with four baſtions, having eight guns mounted on each, carrying a ball of 18 pounds. Two of theſe baſtions face the ſea, the other two the country. Beſides theſe, there is a line of 18 or 20 guns pointing towards the ſea, of 18 and 24 pounders. About a piſtol-ſhot from the back of the fort runs a river, which, beſides being a ſecurity to the factory, adds much to the agreeable ſituation of the place. This river has its ſource in ſome diſtant mountains; and, deſcending in a courſe from the north and eaſt, it afterwards turns in ſeveral pleaſing meanders ſo far to the weſt as to waſh the bottom of the factory's garden, and at laſt winding to the ſouth, it empties itſelf into the ſea. Several beautiful ſmall iſlands too, which are waſhed by its current, diverſify the ſcenery, and greatly heighten the beauty of the proſpect. This ſettlement ſupplies the Eaſt-India Company with pepper; and its ſituation is alſo very convenient for giving proper intelligence to their Company's ſhips touching here from Europe, or from any part of India. E. Long. 76. 1. N. Lat. 7. 0.

ANIL, in botany, a ſynonime of a ſpecies of indigofera. See INDIGOFERA.

ANIMA, among divines and naturaliſts, denotes the ſoul, or principle of life, in animals. See SOUL.

ANIMA, among chemiſts, denotes the volatile or ſpirituous parts of bodies.

ANIMA Hepatis, is a name by which ſome call *ſal martis* or *ſalt of iron*, on account of its ſuppoſed efficacy in diſeaſes of the liver.

ANIMA Mundi, a certain pure ethereal ſubſtance or ſpirit, diffuſed, according to many of the ancient philoſophers, through the maſs of the world, informing, actuating, and uniting the divers parts thereof into one great, perfect, organical, and vital body or animal. Plato treats at large of the ψυχη τȣ κοσμȣ, in his *Timæus;* and is even ſuppoſed to be the author of the *dogma;* yet are interpreters much at a loſs about his meaning. Ariſtotle, however, taking it in the common and obvious ſenſe, ſtrenuouſly oppoſes it. The modern Platoniſts explain their maſter's *anima mundi* by a certain univerſal ethereal ſpirit, which in the heavens exiſts perfectly pure, as retaining its proper nature; but on earth pervading elementary bodies, and intimately mixing with all the minute atoms thereof, it aſſumes ſomewhat of their nature, and becomes of a peculiar kind.—So the poet:

Spiritus

Spiritus intus alit, totosque infusa per artus
Mens agitat molem, et magno se corpore miscet.

They add, that this *anima mundi*, which more immediately resides in the celestial regions as its proper seat, moves and governs the heavens in such a manner, as that the heavens themselves first received their existence from the fecundity of the same spirit: for that this *anima*, being the primary source of life, every where breathed a spirit like itself, by virtue whereof various kinds of things were framed conformable to the divine ideas.

ANIMA *Saturni*, a white powder obtained by pouring distilled vinegar on litharge, of considerable use in enamelling. See ENAMEL.

ANIMADVERSION, in matters of literature, is used to signify, sometimes correction, sometimes remarks upon a book, &c. and sometimes a serious consideration upon any point.

ANIMAL, in natural history, an organized and living body, which is also endowed with sensation: thus, minerals are said to grow or increase, plants to grow and live, but animals alone to have sensation.

It is this property of sensation alone that can be deemed the essential characteristic of an animal; and by which the animal and vegetable kingdoms seem to be so essentially separated, that we cannot even imagine the least approximation of the one to the other. Those naturalists, indeed, who have supposed the distinction between animals and vegetables to consist in any thing else than what we have already mentioned, have found themselves greatly embarrassed; and have generally agreed, that it was extremely difficult, if not impossible, to settle the boundaries between the animal and vegetable kingdoms. But this difficulty will be easily seen to arise from their taking the characteristic marks of the animal kingdom, from something that was evidently common to both. Thus Boerhaave attempted to distinguish an animal from a vegetable, by the former having a mouth, which the latter has not: but here, as the mouth of an animal is only the instrument by which nourishment is conveyed to its body, it is evident that this can be no essential distinction, because vegetables also require nourishment, and have instruments proper for conveying it into their bodies; and where the end is the same, a difference in the means can never be essential. The fixing the difference in an animal's having a gula, stomach, and intestines, as is done by Dr Tyson, is as little to the purpose.

The power of moving from one place to another, hath by many been thought to constitute their difference; and indeed, in most cases, it is the obvious mark by which we distinguish an animal from a vegetable: but Lord Kames hath given several very curious instances of the locomotive power of plants; some of which, he says, would do honour to an animal.—"Upon the slightest touch, the sensitive plant shrinks back and folds up its leaves, similar to a snail; which on the slightest touch retires within its shell. A new species of the sensitive plant hath been lately discovered. See DIONÆA. If a fly perch upon one of its flower-leaves, it closes instantly, and crushes the insect to death. There is not an article in botany more admirable than a contrivance, visible in many plants, to take advantage of good weather, and to protect themselves against bad. They open and close their flowers and leaves in different circumstances: some close before sunset, some after: some open to receive rain, some close to avoid it. The petals of many flowers expand in the sun; but contract at night, or on the approach of rain. After the seeds are fecundated, the petals no longer contract. All the trefoils may serve as a barometer to the husbandman; they always contract their leaves on an impending storm. Some plants follow the sun, others turn from it. Many plants, on the sun's recess, vary the position of their leaves, which is styled the *sleep of plants*. A single plant † was lately discovered in Bengal. Its leaves are in continual motion all day long; but when night approaches, they fall down from an erect posture to rest.

† A species of the *Hedysarum*. See that article.

"A plant has a power of directing its roots for procuring food. The red whortle-berry, a low evergreen plant, grows naturally on the tops of our highest hills, among stones and gravel. This shrub was planted in an edging to a rich border, under a fruit-wall. In two or three years, it over-ran the adjoining deep-laid gravel-walk; and seemed to fly from the border, in which not a single runner appeared. An effort to come at food in a bad situation, is extremely remarkable in the following instance. Among the ruins of Newabbey, formerly a monastery in Galloway, there grows on the top of a wall a plane-tree about 20 feet high. Straitened for nourishment in that barren situation, it several years ago directed roots down the side of the wall, till they reached the ground ten feet below; and now the nourishment it afforded to those roots during the time of their descending is amply repaid, having every year since that time made vigorous shoots. From the top of the wall to the surface of the earth, these roots have not thrown out a single fibre; but are now united in a single root.

"Plants, when forced from their natural position, are endowed with a power to restore themselves. A hop-plant, twisting round a stick, directs its course from south to west, as the sun does. Untwist it, and tie it in the opposite direction: it dies. Leave it loose in the wrong direction: it recovers its natural direction in a single night. Twist a branch of a tree so as to invert its leaves, and fix it in that position: if left in any degree loose, it untwists itself gradually, till the leaves be restored to their natural position. What better can an animal do for its welfare? A root of a tree, meeting with a ditch in its progress, is laid open to the air. What follows? It alters its course like a rational being, dips into the ground, surrounds the ditch, rises on the opposite side to its wonted distance from the surface, and then proceeds in its original direction. Lay a wet sponge near a root laid open to the air; the root will direct its course to the sponge. Change the place of the sponge; the root varies its direction. Thrust a pole into the ground at a moderate distance from a scandent plant: the plant directs its course to the pole, lays hold of it, and rises on it to its natural height. A honeysuckle proceeds in its course, till it be too long for supporting its weight; and then strengthens itself by shooting into a spiral. If it meet with another plant of the same kind, they coalesce for mutual support; the one screwing to the right, the other to the left. If a honeysuckle twig meets with a dead branch, it screws from the right to the left. The claspers of briony shoot into a spiral, and lay hold of whatever comes in their way

for

for support. If, after completing a spiral of three rounds, they meet with nothing, they try again by altering their course."——

By comparing these and other instances of seeming voluntary motion in plants, with that share of life wherewith some of the inferior kinds of animals are endowed, we can scarce hesitate at ascribing the superiority to the former; that is, putting sensation out of the question. Muscles, for instance, are fixed to one place as much as plants are; nor have they any power of motion, besides that of opening and shutting their shells: and in this respect they have no superiority over the motion of the sensitive plant; nor doth their action discover more sagacity, or even so much, as the roots of the plane-tree mentioned by Lord Kames.

Mr Buffon, who seems to be desirous of confounding the animal and vegetable kingdoms, denies sensation to be any essential distinction. "Sensation (says he) more essentially distinguishes animals from vegetables: but sensation is a complex idea, and requires some explication. For if sensation implied no more than motion consequent upon a stroke or an impulse, the sensitive plant enjoys this power. But if, by sensation, we mean the faculty of perceiving and comparing ideas, it is uncertain whether brute animals are endowed with it. If it should be allowed to dogs, elephants, &c. whose actions seem to proceed from motives similar to those by which men are actuated, it must be denied to many species of animals, particularly to those which appear not to possess the faculty of progressive motion. If the sensation of an oyster, for example, differed only in degree from that of a dog; why do we not ascribe the same sensation to vegetables, though in a degree still inferior? This distinction, therefore, between the animal and vegetable, is neither sufficiently general nor determined.

"From this investigation we are led to conclude, that there is no absolute and essential distinction between the animal and vegetable kingdoms; but that nature proceeds, by imperceptible degrees, from the most perfect to the most imperfect animal, and from that to the vegetables; and the fresh-water polypus may be regarded as the last of animals and the first of plants."

It were to be wished, that philosophers would on some occasions consider, that a subject may be dark as well on account of their inability to see, as when it really affords no light. Our author boldly concludes, that there is no essential difference between a plant and an animal, because we ascribe sensation to an oyster, and none to the sensitive plant; but we ought to remember, that though we cannot perceive a distinction, it may nevertheless exist. Before Mr Buffon, therefore, had concluded in this manner, he ought to have proved that some vegetables were endowed with sensation.

It is no doubt, however, as much incumbent on those who take the contrary side of the question, to prove that vegetables are not endowed with sensation, as it was incumbent on Mr Buffon to have proved that they are. But a little attention will show us, that the difficulty here proceeds entirely from our inability to see the principle of sensation. We perceive this principle in ourselves, but no man can perceive it in another. Why then does every individual of mankind conclude that his neighbour has the same sensations with himself? It can only be from analogy. Every man perceives his neighbour formed in a a manner similar to himself; he acts in a similar manner on similar occasions, &c. Just so it is with brute animals. It is no more doubtful that they have sensations, than that we have them ourselves. If a man is wounded with a knife, for instance, he expresses a sense of pain, and endeavours to avoid a repetition of the injury. Wound a dog in the same manner, he will also express a sense of pain; and, if you offer to strike him again, will endeavour to escape, before he feels the stroke. To conclude here, that the action of the dog proceeded from a principal different from that of the man, would be absurd and unphilosophical to the last degree.

We must further take notice, that there are sensations essentially distinct from one another; and in proportion as an animal is endowed with more or fewer of these different species, it is more or less perfect as an animal: but, as long as one of them remains, it makes not the least approach to the vegetable kingdom; and, when they are all taken away, is so far from becoming a vegetable, that it is only a mass of dead matter. The senses of a perfect animal, for instance, are five in number. Take away one of them, suppose sight; he becomes then a less perfect animal, but is as unlike a vegetable as before. Suppose him next deprived of hearing: his resemblance to a vegetable would be as little as before; because a vegetable can neither feel, taste, nor smell, and we suppose him still to enjoy these three senses. Let us, lastly, suppose him endowed only with the sense of feeling, which, however, seems to include that of taste, and he is no more a vegetable than formerly, but only an imperfect animal. If this sense is then taken away, we connect him not with the vegetable kingdom, but with what Mr Buffon calls *brute-matter*. It is to this kingdom, and not to the vegetable, that animals plainly approximate as they descend. Indeed, to suppose an approximation between the vegetable and animal kingdoms, is very absurd: for, at that rate, the most imperfect animal ought to be the most perfect plant; but we observe no such thing. All animals, from the highest to the lowest, are possessed of vegetable life; and that, as far as we can perceive, in an equal degree, whether the animal-life is perfect or imperfect: nor doth there seem to be the smallest connection between the highest degree of vegetation and the lowest degree of sensation. Though all animals, therefore, are possessed of vegetable life, these two seem to be as perfectly distinct and incommensurate to one another as any two things we can possibly imagine.

The power of vegetation, for instance, is as perfect in an onion or leek, as in a dog, an elephant, or a man: and yet, though you threaten a leek or an onion ever so much, it pays no regard to your words, as a dog would do; nor, though you wound it, does it avoid a second stroke. It is this principle of self-preservation in all animals, which, being the most powerful one in their nature, is generally taken, and with very good reason, as the true characteristic of animal-life. This principle is undoubtedly a consequence of sensation; and as it is never observed to take place in vegetables, we have a right to say that the foundation of it, namely sensation, belongs not to them. There is no animal, which makes any motion in consequence of external impulse where danger is threatened, but what puts itself in a posture of defence; but no vegetable whatever

ever does so. A muscle, when it is touched, immediately shuts its shell; and as this action puts it in a state of defence, we conclude that it proceeded from the principle of self-preservation. When the sensitive plant contracts from a touch, it is no more in a state of defence than before; for whatever would have destroyed it in its expanded state, will also do it in its contracted state. We conclude, therefore, that the motion of the sensitive plant proceeds only from a certain property called by physicians *irritability*; and which, though our bodies possess it in an eminent degree, is a characteristic neither of animal nor vegetable life, but belongs to us in common with brute-matter. It is certain, that an electrified silk-thread shews a much greater variety of motions than any sensitive plant. If a bit of silk-thread is dropt on an electrified metal-plate, it immediately erects itself; spreads out the small fibres like arms; and, if not detained, will fly off. If a finger is brought near it, the thread seems greedily to catch at it. If a candle approaches, it claps close to the plate, as if afraid of it.—Why do we not conclude that the thread in this case is really afraid of the candle? For this plain reason, That its seeming flight is not to get away from the candle, but to get towards the electrified metal; and, if allowed to remain there, will suffer itself to be burnt without offering to stir.—The sensitive plant, in like manner, after it has contracted, will suffer itself to be cut in pieces, without making the least effort to escape. The case is not so with the meanest animal. An hedge-hog, when alarmed, draws its body together, and expands its prickles, thereby putting itself in a posture of defence. Throw it into water; and the same principle of self-preservation prompts it to expand its body and swim. A snail, when touched, withdraws itself into its shell: but if a little quicklime is sprinkled upon it, so that its shell is no longer a place of safety, it is thrown into agonies, and endeavours to avail itself of its locomotive power in order to escape the danger. In muscles and oysters, indeed, we cannot observe this principle of self-preservation so strongly, as nature has deprived them of the power of progressive motion: but, as we observe them constantly to use the means which nature has given them for self-preservation, we can have no reason to think that they are destitute of that principle upon which it is founded.

But there is no need of arguments drawn from the inferior creation. We ourselves are possessed both of the animal and vegetable life, and certainly must know whether there is any connection between vegetation and sensation or not.—We are conscious that we exist; that we hear, see, &c.: but of our vegetation we are absolutely inconscious. We feel a pleasure, for instance, in gratifying the calls of hunger and thirst; but of the process by which our aliment is formed into chyle, the chyle mixed with the blood, the circulation of that fluid, and the separation of all the humours from it, we are altogether ignorant. If we then, who are more perfect than other vegetables, are utterly insensible of our own vegetable life, why should we imagine that the less perfect vegetables are sensible of it?

To illustrate our reasoning here by an example.—The direction of the roots of the plane-tree mentioned by Lord Kames, shows as much sagacity, if we are to look only to the outward action, as can be observed in any motion of the most perfect animal whatever; nevertheless, we have not the least suspicion, either that the tree saw the ground at a distance, or that it was informed of its being there by the rest of its roots. If a wound is made in the body of a man, and a loss of substance is to be repaired, the same sagacity will be observed in the arrangement of the fibres, not only as if they were animated, but they will dispose of themselves seemingly with a degree of wisdom far superior to what we have any idea of; yet this is done without our having the least knowledge either how it is done, or of its being done at all. We have therefore in ourselves a demonstration, that vegetable life acts without knowing what it does: and if vegetables are ignorant of their most sagacious actions, why should we suspect that they have a sensation, let it be ever so obscure, of any of their inferior ones, such as contracting from a touch, turning towards the sun, or advancing to meet a pole?

Thus we may easily give Mr Buffon a reason why we ascribe sensation to an oyster, and none to a vegetable; namely, because we perceive the vegetable do nothing but what is also performed in our own bodies, without our having the least sensation of it; whereas an oyster puts itself in a defensive posture on the approach of danger; and this being an action similar to our own upon a like occasion, we conclude that it proceeds from the same principle of sensation. Here it may also be observed, that though the inferior animals are deficient in the number, they are by no means so in the acuteness of their sensations; on the contrary, though a muscle or an oyster is probably endowed with no other sense than that of feeling, yet this sense is so exquisite, that it will contract upon the slightest touch, such as we would be altogether insensible of.

As to that power of contractility, or iritability, which is observed in some plants; our solids have it, when deprived both of vegetable and animal life: for a muscle, cut out of a living body, will continue to contract, if it is irritated by pricking it, after it has neither sensation nor vegetation.

A very good moral reason may also be adduced why we do not believe vegetables to be endowed with sensation.—Had they been so, we must suppose them to suffer pain when they are cut or destroyed; and, if so, what an unhappy state must they be in, who have not the least power to avoid the injuries daily offered them? In fact, the goodness of the Deity is very conspicuous in not giving to vegetables the same sensations as to animals; and, as he hath given them no means of defence, though we have not been told it by himself, we might have known that he gave them for food to animals; and, in this case, to have endowed them with sensation would have been a piece of cruelty. Though animals without number prey upon one another, yet all of them have some means of defence; from whence we may justly conclude, that their mutual destruction was not an original appointment of the Creator, but what he foresaw would happen in the course of time, and which he therefore gave every one of them some means of guarding against. It may no doubt be here objected, that the giving some means of self-defence to every animal cannot be reckoned a sufficient proof that it was not the original design of the Creator that they should be destroyed, seeing these means are not always effectual for their preservation.—This objection, however, Animal.

ever, cannot be completely obviated without a solution of the question concerning the origin of evil among the works of a perfectly good Being. But whatever difficulty there may be in solving this question, it is certain, that, as some means of self-defence is given to every animal, it has been the original design of the Creator, that in all cases one species of animals should not be destroyed at the pleasure of any other species; and as no means of self-defence is given to any vegetable, it is plain that they have been destined for a prey to every species of animals that had access to them. Philosophers have insisted much on the necessity of one animal's devouring another, that there might be room sufficient for all; but this, so far from being a system worthy of the divine wisdom, seems to us to be a reflection upon it, as if the Author of nature could not have found means to preserve the life of one part of his creatures, without the destruction and misery of the rest. The sacred writings leave us at no loss to see how this carnivorous disposition came in; and, in the next world, this piece of perfection (as the sanguinary philosophers above-mentioned would have it to be) seems to be left out; for there, it is said, "They shall not hurt nor destroy; the lion shall eat straw like the ox, and there shall be no more pain."

When speaking of the food of plants, we took occasion to mention a certain power, totally different from that of attraction or repulsion, by which the food of a plant, after it was attracted, or otherwise brought to it, was assimilated to its substance. This power which we there distinguish by the name of *transmutation*, belongs in a more eminent degree to animals. The alimentary substance is changed into two kinds of matter. (1.) An excrementitious one, which passes off through the intestines; and (2.) A fluid, which is the direct pabulum of the animal. Different substances, however, are not equally changeable by this process. The human stomach is not capable of acting upon any animal substance till it has lost its vital principle: the stomachs of some animals cannot act upon creatures of their own species: some have an apparatus for grinding their food after it is swallowed, &c. and there are no animals but what are subject to death by taking certain substances into their stomach. Some substances also, though they resist the action of the stomach, and pass unchanged into the system, produce no bad effects. Thus, madder will turn the bones of animals red; rhubarb will communicate its purgative nature to the milk, and its deep yellow colour to the urine.—All these changes, however, seem to belong to the vegetative part of our system: for as every one of them are performed without our knowledge of the manner how; and not only so, but while we are absolutely unconscious of their being done; we can have no reason to suppose, that the *animal* life, properly so called, is at all connected with them, any farther than as they are at present the means of preserving the creature alive, and making the connection betwixt the principle of life and this visible creation.

The description and classing of animals make a considerable part of Natural History, known by the name of *Zoology*. See the article ZOOLOGY.

For particulars relating to different animals, their analogous structure, sagacity, instinct, peculiarities, &c. see COMPARATIVE *Anatomy*, INSTINCT, MIGRATION, AMPHIBIOUS, QUADRUPED, SINGING, ORNITHOLOGY, VIVIPAROUS, OVIPAROUS, ICHTHYOLOGY, ENTOMOLOGY, &c.

ANIMAL, used adjectively, denotes any thing belonging to, or partaking of, the nature of animals. Thus, animal actions, those that are peculiar to animals; such are sensation and muscular motion.

ANIMAL-Flower, in zoology, a name given to several species of animals belonging to the genus of ACTINIA of Linnæus. They have likewise been distinguished by the names of *Urtica Marina*, or *Sea-nettle*, from their supposed property of stinging; and *Sea-anemone*, from their claws or tentacles being disposed in regular circles, and tinged with a variety of bright lively colours, resembling the petals of some of our most beautiful flowers. As to one species particularly, mentioned by Abbé Diequemarre, (Phil. Transf. for 1773, art. 37.) the purest white, carmine, and ultramarine, are said to be scarce sufficient to express their brilliancy. The bodies of some of them are hemispherical, of others cylindrical, and of others shaped like a fig. Their substance likewise differs; some are stiff and gelatinous, others fleshy and muscular; but all of them are capable of altering their figure when they extend their bodies and claws in search of food. They are found in many of the rocky coasts of the West-India islands, and likewise on some parts of the coast of England.

They have only one opening, which is in the centre of the uppermost part of the animal; round this are placed rows of fleshy claws; this opening is the mouth of the animal, and is capable of great extension. The animals themselves, though exceedingly voracious, will bear long fasting. They may be preserved alive a whole year, or perhaps longer, in a vessel of sea-water, without any visible food; but, when food is presented, one of them will successively devour two muscles in their shells, or even swallow a whole crab as large as a hen's egg. In a day or two the crab-shell is voided at the mouth, perfectly cleared of all the meat. The muscle-shells are likewise discharged whole, with the two shells joined together, but entirely empty, so that not the least particle of fish is to be perceived on opening them. An anemone of one species will even swallow an individual of another species; but, after retaining it ten or twelve hours, will throw it up alive and uninjured. Through this opening also it produces its young ones alive, already furnished with little claws, which, as soon as they fix themselves, they begin to extend in search of food.

One of the extremities of the sea-anemone resembles, as we have said, the outward leaves of that flower; while its limbs are not unlike the shag or inner part of it. By the other extremity it fixes itself, as by a sucker, to the rocks or stones lying in the sand; but it is not totally deprived of the power of progressive motion, as it can shift its situation, though very slowly.

A particular species of animal-flowers has been found in some of the British West-India islands; and the following account of them was published by the Philosophical Transactions, vol. 75. by Mr Ellis, in a letter to Lord Hillsborough.

"This compound animal, which is of a tender fleshy substance, consists of many tubular bodies, swelling gently towards the upper part, and ending like a bulb or

Animal Flower.

or very ſmall onion; on the top of each is its mouth, ſurrounded by one or two rows of tentacles, or claws, which when contracted look like circles of beads.

"The lower part of all theſe bodies have a communication with a firm fleſhy wrinkled tube, which ſticks faſt to the rocks, and ſends forth other fleſhy tubes, which creep along them in various directions. Theſe are full of different ſizes of theſe remarkable animals, which riſe up irregularly in groups near to one another.

"This adhering tube, that ſecures them faſt to the rock, or ſhelly bottom, is worthy of our notice. The knobs that we obſerve, are formed in ſeveral parts of it by its inſinuating itſelf into the inequalities of the coral rock, or by graſping pieces of ſhells, part of which ſtill remain in it, with the fleſhy ſubſtance grown over them.

"This ſhows us the inſtinct of nature that directs theſe animals to preſerve themſelves from the violence of the waves, not unlike the anchoring of muſcles, by their fine ſilken filaments that end in ſuckers; or rather like the ſhelly baſis of the ſerpula, or worm-ſhell, the tree-oyſter, and the ſlipper barnacle, &c. whoſe baſes conform to the ſhape of whatever ſubſtance they fix themſelves to, graſping it faſt to their teſtaceous claws, to withſtand the fury of a ſtorm.

"When we view the inſide of this animal diſſected lengthwiſe, we find like a little tube leading from the mouth to the ſtomach, from whence there riſe eight wrinkled ſmall guts, in a circular order, with a yellowiſh ſoft ſubſtance in them; theſe bend over in the form of arches towards the lower part of the bulb, from whence they may be traced downwards, to the narrow part of the upright tube, till they come to the fleſhy adhering tube, where ſome of them may be perceived entering into a papilla, or the beginning of an animal of the like kind, moſt probably to convey it nouriſhment till it is provided with claws: the remaining part of theſe ſlender guts are continued on in the fleſhy tube, without doubt for the ſame purpoſe of producing and ſupporting more young ones from the ſame common parent.

"The many longitudinal fibres that we diſcover lying parallel to each other, on the inſide of the ſemitranſparent ſkin, are all inſerted in the ſeveral claws round the animal's mouth, and are plainly the tendons of the muſcles, for moving and directing the claws at the will of the animal: theſe may be likewiſe traced down to the adhering tube.

"As this ſpecimen has been preſerved in ſpirits, the colour of the animal, when living, cannot be certainly known; it is at preſent of a pale yellowiſh brown.

"With regard to its name, it may be called *Actinia ſociata*, or the *Cluſter Animal-flower.*"

The Abbé Dicquemarre, by many curious though cruel, experiments related in the Phil. Tranſ. for 1773, has ſhown that theſe animals poſſeſs, in a moſt extraordinary degree, the power of reproduction; ſo that ſcarce any thing more is neceſſary to produce as many ſea-anemonies as we pleaſe, than to cut a ſingle one into as many pieces. A ſea-anemone being cut in two by a ſection through the body, that part, where the limbs and mouth are placed, eat a piece of a muſcle offered to it ſoon after the operation, and continued to feed and grow daily for three months after. The food ſometimes paſſed through the animal; but was generally thrown up again, conſiderably changed, as in the perfect ſea-anemone. In about two months, two rows of limbs were perceived growing out of the part where the inciſion was made. On offering food to this new mouth, it was laid hold of and eat; and the limbs continually increaſing, the animal gradually became as perfect as thoſe which had never been cut. In ſome inſtances, however, he found, that, when one of theſe creatures was cut through, new limbs would be produced from the cut place, thoſe at the mouth remaining as before; ſo that a monſtrous animal was the conſequence, having two mouths, and feeding at both ends. Having put ſome of them into a pan of water, ſet over a ſlow fire, he found that they loſt their life at 50 degrees of Reamur's thermometer. To avoid the imputation of cruelty in theſe experiments, the author argues the favourable conſequences that have attended his operations on the ſea-anemonies which have been ſo fortunate as to fall into his hands; as he hath not only multiplied their exiſtence, but alſo renewed their youth; which laſt, he adds, "is ſurely no ſmall advantage."

Animal-Flower.

In Hughes's Natural Hiſtory of Barbadoes an account is alſo given of ſeveral ſpecies of animal-flowers. They are there deſcribed as only found in a baſon in one particular cave; and of the moſt remarkable ſpecies mentioned by him we have the following deſcription.

"In the middle of the baſon, there is a fixed ſtone, or rock, which is always under water. Round its ſides, at different depths, ſeldom exceeding 18 inches, are ſeen, at all times of the year, iſſuing out of little holes, certain ſubſtances that have the appearance of fine radiated flowers, of a pale yellow, or a bright ſtraw colour, ſlightly tinged with green, having a circular border of thick-ſet petals, about the ſize of, and much reſembling thoſe of a ſingle garden-marigold, except that the whole of this ſeeming flower is narrower at the diſcus, or ſetting on of the leaves, than any flower of that kind.

"I have attempted to pluck one of theſe from the rock, to which they are always fixed; but never could effect it: for as ſoon as my fingers came within two or three inches of it, it would immediately contract cloſe together its yellow border, and ſhrink back into the hole of the rock; but if left undiſturbed for about four minutes, it would come gradually in ſight, expanding, though at firſt very cautiouſly, its ſeeming leaves, till at laſt it appeared in its former bloom. However, it would again recoil, with a ſurpriſing quickneſs, when my hand came within a ſmall diſtance of it. Having tried the ſame experiment by attempting to touch it with my cane, and a ſmall ſlender rod, the effect was the ſame.

"Though I could not by any means contrive to take or pluck from the rock one of theſe animals entire; yet I once cut off (with a knife which I had held for a long time out of ſight, near the mouth of an hole out of which one of theſe animals appeared) two of theſe ſeeming leaves. Theſe, when out of the water, retained their ſhape and colour; but, being compoſed of a membrane-like ſubſtance, ſurpriſingly thin, it ſoon ſhrivelled up, and decayed."

The reproductive power of the Barbadoes animal-flower is prodigious. Many people coming to ſee theſe ſtrange creatures, and occaſioning ſome inconve-

Animal-Food ‖ Animalcule. nience to a person through whose grounds they were obliged to pass, he resolved to destroy the objects of their curiosity; and, that he might do so effectually, caused all the holes out of which they appeared to be carefully bored and drilled with an iron instrument, so that we cannot suppose but their bodies must have been entirely crushed to a pulp: nevertheless, they again appeared in a few weeks from the very same places.

Plate XXXII. fig. 1. represents the actinia sociata, or clustered animal-flower, described by Mr Ellis, with its radical tube adhering to a rock: (a) One of the animals stretching out its claws. Fig. 2. A perpendicular dissection of one of the bodies, to show the gullet, intestines, stomach, and fibres or tendons that move the claws: (a) A young one arising out of the adhering tube. Fig. 3. The actinia aster, or animal-flower of the newly ceded islands. Fig. 4. The actinia anemone, or sea-anemone from the same place. Fig. 5. The under part of the same by which it adheres to the rocks. Fig. 6. The actinia helianthus, or the sea-sunflower from ditto. Fig. 7. The under part of the same. Fig. 8. The actinia dianthus, or sea-carnation, from the rocks at Hastings in Sussex. This animal adheres by its tail, or sucker, to the under part of the projecting rocks opposite to the town; and, when the tide is out, has the appearance of a long white fig: this is the form of it when put into a glass of sea-water. It is introduced here as a new variety of this animal not yet described.

Animal-Food. See Food.

Animal-Oeconomy. This subject is explained under Anatomy.

Animal-Magnetism. See Magnetism.

Animal-Spirit. See *Nervous Fluid.*

Animal-System denotes the whole class of beings endowed with animal life, otherwise called *Animal Kingdom.*

Animals, the preparation of, for collections or museums. See Quadrupeds, Birds, Reptiles.

Pairing of Animals. See Pairing.

1 Common acceptation of the word. ANIMALCULE, in general, signifies a little animal; and thus the term might be applied to every animal which is considerably inferior in size to ourselves. It hath been customary, however, to distinguish by the name of *animalcules* only such animals as are of a size so diminutive, that their true figure cannot be discerned without the assistance of glasses; and more especially it is applied to such as are altogether invisible to the naked eye, and cannot even be perceived to exist but by the assistance of microscopes.

By the help of magnifying glasses, we are brought into a kind of new world; and numberless animals are discovered, which, from their minuteness, must otherwise for ever have escaped our observation: and how many kinds of these invisibles there may be, is still unknown; as they are discerned of all sizes, from those which are barely invisible to the naked eye, to such as resist the action of the microscope, as the fixed stars do that of the telescope, and with the best magnifiers hitherto invented appear only as so many moving points. 2 Different sizes of animalcules.

The smallest living creatures our instruments can show are those that inhabit the waters: for though possibly animalcules equally minute, or perhaps more so, may fly in the air, or creep upon the earth, it is scarce possible to bring such under our examination; but water being transparent, and confining the creatures in it, we are able, by applying a drop of it to our glasses, to discover, to a certain degree of smallness, all that it contains.—Some of the most curious of these animalcules, which have been described by microscopical observers, we shall here give an account of. Animalcule.

3 Hair-like insect. 1. *The Hair-like Insect.* This is so called by Mr Baker on account of its shape; being extremely slender, and frequently an hundred and fifty times as long as broad. The body or middle part, which is nearly straight, appears, in some, composed of such rings as the wind pipe of land-animals is made up of; but in others, seems rather scaled, or made up of rings that obliquely cross one another. Its two ends are hooked or bent, pretty nearly in the same degree, but in a direction opposite to one another; and as no eyes can be discerned, it is difficult to judge which is the head or tail. Its progressive * motion is very singular, being performed by turning upon one end as a centre, and describing almost a quarter of a circle with the other, as represented in the figure. Its motions are very slow, and require much patience and attention in the observer. These creatures are so small, that millions of millions of them might be contained in an inch square. When viewed singly, they are exceedingly transparent, and of a beautiful green colour; but when numbers of them are brought together, they become opaque, lose their green colour, and grow entirely black. 4 Its extreme smallness, &c.

* Plate, XXXIII. fig. 1.

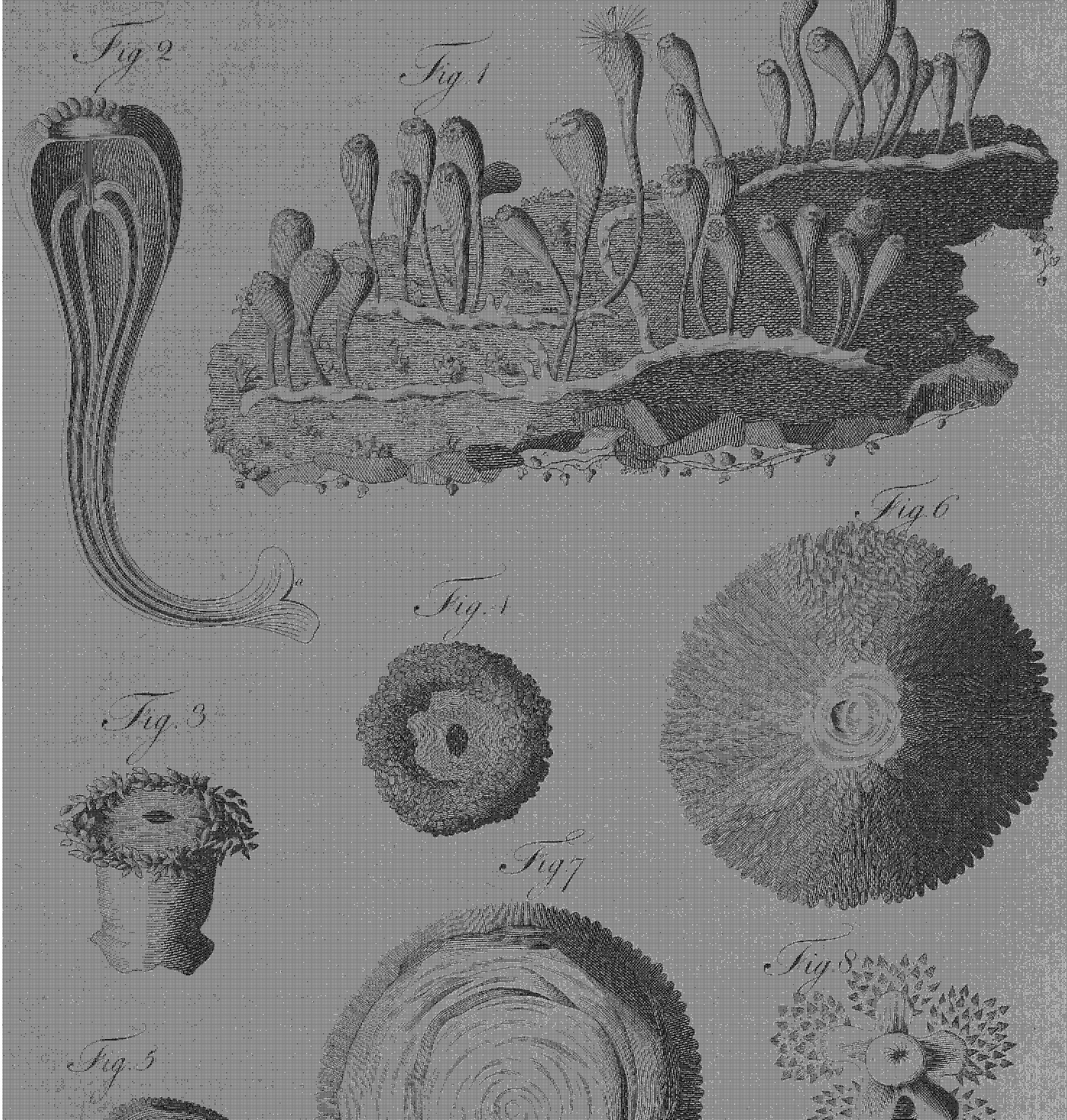
5 Delights in society. Notwithstanding the extreme minuteness of these animalcules, they seem to be fond of society; for, after viewing for some time a parcel of them taken up at random, they will be seen disposing themselves in a kind of regular order †. If a multitude of them are put into a jar of water, they will form themselves into a regular body, and ascend slowly to the top, where, after they have remained for some time exposed to the air, their green colour changes to a beautiful sky-blue. When they are weary of this situation, they form themselves into a kind of rope, which slowly descends as low as they intend; but if they happen to be close to the side of the jar, they will descend upon it. They are so nearly of the specific gravity of water itself, that they will either remain at the bottom, float on the surface, or be suspended in the middle, according as they are originally placed, or as they themselves have a mind.

† Fig. 2.

A small quantity of the matter containing these animalcules ‡ having been put into a jar water, it so happened, that one part went down immediately to the bottom, whilst the other continued floating on the top. When things had remained for some time in this condition, each of these swarms of animalcules began to grow weary of its situation, and had a mind to change its quarters. Both armies, therefore, set out at the same time, the one proceeding upwards, and the other downwards; so that, after some hours journey, they met in the middle. A desire of knowing how they would behave on this occasion, engaged the observer to watch them carefully; and to his surprise he saw the army that was marching upwards, open to the right and left, to make room for those that were descending. Thus, without confusion or intermixture, each held on its way; the army that was going up, marching in two columns to the top, and the other proceeding in one column to the bottom, as if each had been under the direction of wise leaders. 6 Seems possessed of a considerable degree of sagacity.

‡ Fig. 3.

The hair-like insect was first discovered in a ditch at Norwich, ANIMAL FLOWERS Plate XXXII



Animalcule

7 Found in prodigious quantity.

Norwich, one end of which communicates with the river there, and the other end with a fecond ditch into which feveral kennels empty themfelves. The length of this ditch, when Mr Baker wrote his account of this animalcule, was as leaft 100 yards, and its breadth nine. The bottom, for more than a foot thick, was covered with a blackifh green fubftance, in appearance like mud, made up for the moft part of thefe infects; but, fuppofing only an half or a quarter part of it to be compofed of them, according to the dimenfions we have given, their numbers muft exceed all imagination.

2. *Eels in pafte*, &c. When pafte is allowed to ftand till it becomes four, it is then found to be the habitation of numberlefs animalcules, which may be difcerned by the naked eye; and though their form cannot be perfectly diftinguifhed, their motion is very perceptible, and the whole pafte will feem to be animated.

8 Eels in pafte viviparous.

Fig. 4. reprefents one of thefe anguillæ magnified. The moft remarkable property of thefe infects is, that they are viviparous. If one of them is cut thro' near the middle, feveral oval bodies of different fizes will be feen to iffue forth. Thefe are young anguillæ, each of them coiled up and inclofed in its proper membrane, which is fo exquifitely fine, as fcarce to be difcernible by the greateft magnifier, while it inclofes the embryo animal. The largeft and moft forward immediately break through this covering, unfold themfelves, and wriggle about in the water nimbly; others get out, uncoil, and move themfelves about more flowly; and the leaft mature continue entirely without motion. The *uterus*, or veffel that contains all thefe oval bodies, is compofed of many ringlets, not unlike the afpera arteria of land-animals, and feems to be confiderably elaftic; for as foon as the animalcule is cut in two, the oval bodies are thruft out with fome degree of violence, from the fpringing-back or action of this bowel. An hundred and upwards of the young ones have been feen to iffue from the body of one fingle eel, whereby the prodigious increafe of them may be accounted for; as probably feveral fuch numerous generations are produced in a fhort time. They feem to be all prolific; and unlefs trial happens to be made upon one that has brought forth all its young, or when the pafte has been kept for a very long time, the experiment will always fucceed.—This property of thefe eels being viviparous renders it highly improbable that they ever become flies.

Animalcules of a fimilar kind are likewife found in vinegar; and like thofe already defcribed, are found to be viviparous. But it is not only in acid matters that fuch appearances are obferved. In fome fields of wheat, many grains may be obferved, that appear blackifh outwardly, as if fcorched; but, when opened, are found to contain a foft white fubftance, which, attentively confidered, appears to be nothing elfe than a congeries of threads or fibres lying clofe to each other in a parallel direction, much refembling the unripe down of fome thiftles on cutting open the flower-heads before they begin to blow. This fibrous matter difcovers not the leaft fign of life or motion, unlefs water is applied; but immediately on wetting, provided the grains of wheat have been newly gathered, the fuppofed fibres feparate, and appear to be living creatures. Their motions at firft are very languid; but gradually become more vigorous, twifting and wriggling themfelves fomewhat in the manner of the eels in pafte, but always flower than they, and with a great deal of lefs regularity.

9 Similar creatures found in blighted wheat.

If the grains of wheat are grown dry by keeping, and in that condition are cut open, the fibrous matter is very diftinguifhable; and, on putting water to it, will feparate with great readinefs, and feem like fine tubes or threads tapering at both ends: but not the leaft motion will be perceived till they have been in water for feveral hours, and fometimes they will never move at all. But if the fame grains are fteeped in water for three or four hours, or buried for fome days in the earth till they are fully faturated with moifture, and then opened with a penknife; on taking out a fmall portion of the white matter carefully, and fpreading it thin upon a flip of glafs, the animalcules will be feen bundled together, and extended longitudinally, but without motion: and though, upon the application of water, they will not revive fo foon as thofe taken from frefh grains, whofe moifture has never been exhaled; yet, after remaining an hour or two in water, they are conftantly found alive and vigorous, even though the grains have been kept in a dry condition for feveral years.—It is neceffary, however, to adapt, in fome meafure, the time of continuing the grains in water or earth to the age and drynefs of them: for if they are not opened before they are too much foftened, the animalcules will be dead; and unlefs the hufks are opened to let thofe creatures out after they have been fteeped, they inevitably perifh in them: otherwife, they will continue alive in water for many months; and fhould the water dry away, may be revived again by giving them a frefh fupply.

10 How difcoverable.

11 Precautions neceffary in making the experiment

3. *The Proteus.* This animacule has been dignified by Mr Baker with the name of *Proteus*, on account of its affuming a great number of different fhapes, fo as fcarce to be known as the fame animal in its various transformations; and indeed unlefs it be carefully watched while paffing from one fhape to another, it will often become fuddenly invifible, as happened more than once to Mr Baker.

12 Proteus why fo called.

When water, wherein any fort of vegetable has been infufed, or animals preferved, has ftood quietly for fome days, or weeks, in any glafs or other veffel, a flimy fubftance will be collected about the fides: fome of which being taken up with the point of a penknife, placed on a flip of glafs in a drop of water, and looked at through the microfcope, will be found to harbour feveral kinds of little animals that are feldom found fwimming about at large; among which the proteus is one. Its fhape is better underftood from the figure, than from any defcription that could be given. Its fubftance and colour feems to refemble that of a fnail; and its whole fhape feems to bear a confiderable refemblance to that of a fwan. It fwims to and fro with great vivacity: but will now and then ftop for a minute or two; during which time its long neck is ufually employed as far as it can reach, forwards, and on every fide, with a fomewhat flow, but equable motion, like that of a fnake, frequently extending thrice the length of its body, and feemingly in fearch of food.

13 Where found.

14 Its fhape, colour, &c.

There are no eyes, nor any opening in the head like a mouth, to be difcerned: but its actions plainly prove it to be an animal that can fee; for though multitudes of different animalcules fwim about in the fame water, and its own progreffive motion is very fwift, it never

Animalcule. ſtrikes againſt any of them, but directs its courſe between them with a dexterity wholly unaccountable ſhould we ſuppoſe it deſtitute of ſight.

15 Its transformations. When the proteus is alarmed, it ſuddenly draws in its long neck, repreſented in fig. 5. and 6. transforming itſelf into the ſhape repreſented in fig. 7. when it becomes more opaque, and moves about very ſlowly with the large end foremoſt. When it has continued ſome time in this poſture, it will often, inſtead of the head and neck it had formerly, put forth a new one, with a kind of wheel machinery, repreſented fig. 8. the motions of which draw a current of water to it from a conſiderable diſtance. Having often pulled in and thruſt out this ſhort head, ſometimes with and ſometimes without the wheel-work, the creature, as if weary, will remain motionleſs for a while; then its head and long neck will be very ſlowly protruded, as in fig. 9. and it ſoon reſumes its former agility. Sometimes it diſpoſes of its neck and head as repreſented in fig. 10.

16 Vorticella, where found. 4. *The Wheel-Animal, or Vorticella.* This wonderful animalcule is found in rain water that has ſtood ſome days in leaden gutters, or in hollows of lead on the tops of houſes; or in the ſlime or ſediment left by ſuch water; and perhaps may alſo be found in other places: but if the water ſtanding in gutters of lead, or the ſediment left behind it, has any thing of a red colour in it, one may be almoſt certain of finding them therein. Though it diſcovers no ſigns of life except when in the water, yet it is capable of continuing alive for many months after it is taken out of the water, and kept in a ſtate as dry as duſt. In this ſtate it is of a globular ſhape, exceeds not the bigneſs of a grain of ſand, and no ſigns of life appear: but, being put into water, in the ſpace of half an hour, a languid motion begins, the globule turns itſelf about, lengthens itſelf by ſlow degrees, aſſumes the form of a lively maggot, and moſt commonly in a few minutes afterwards puts out its wheels; ſwimming vigorouſly through the water, as if in ſearch of food; or elſe, fixing itſelf by the tail, works the wheels in ſuch a manner as to bring its food to it.

Fig. 23. and 24. ſhow the wheel-animal in its globular form; fig. 11. and 12. in its maggot ſtate; and fig. 13, 14, 15, 16, 17, 18, 19, 20, 21, and 22. ſhow the different appearances of its wheels, and alſo its various intermediate changes between the globular and maggot ſtate.

17 Its wheel-work deſcribed. The moſt remarkable part of this animalcule is its wheel-work. This conſiſts of a couple of ſemicircular inſtruments, round the edges of which many little fibrillæ move themſelves very briſkly, ſometimes with a kind of rotation, and ſometimes in a trembling or vibrating manner. When in this ſtate, it ſometimes unfaſtens its tail, and ſwims along with a great deal of ſwiftneſs, ſeemingly in purſuit of its prey. Sometimes the wheels ſeem to be entire circles, armed with ſmall teeth like thoſe of the balance-wheel of a watch, appearing projected forwards beyond the head, and extending ſideways ſomewhat wider than its diameter. The teeth or cogs of theſe wheels ſeem to ſtand very regularly at equal diſtances: but the figure of them varies according to their poſition, the degree of their protruſion, and perhaps the will of the animal itſelf. They appear ſometimes like minute oblong ſquares, riſing at right angles from the periphery of a circle, like ancient battlements on a round tower; at other times they terminate in ſharp points, and all together reſemble a kind of Gothic crown. They are often ſeen in a kind of curvular direction, all bending the ſame way, and ſeeming like ſo many hooks; and now and then the ends of them will be perceived to be clubbed like mallets. This figure, however, as well as the firſt, they aſſume but rarely.

As theſe wheels are every where exceſſively tranſparent, except about their circular rim or edge, where the cogs are ſet, it is very difficult to determine by what contrivance they are turned about, or what their real figure is, though they ſeem exactly to reſemble wheels moving round upon an axis. It is alſo hardly poſſible to be certain whether thoſe circular bodies in which the teeth are ſet, are of a flat form, or hollow and conical; but they ſeem rather to be of a conical figure. The difficulty of conceiving how an articulation could be contrived ſo as to cauſe a real rotation, hath cauſed many people imagine that there was a deception in this caſe: But Mr Baker aſſures us, that when the wheels are fully protruded, they never fail to ſhow all the viſible marks of a regular rotation; and, in ſome poſitions, the ſame cogs or teeth may be traced by the eye during a complete revolution. 18 Shows all the marks of real rotation.

All the actions of this creature ſeem to imply ſagacity and quickneſs of ſenſation. At the leaſt touch or motion in the water, they inſtantly draw in their wheels; and Mr Baker conjectures, that their eyes are lodged ſomewhere about the wheels: becauſe, while in the maggot-ſtate, its motions are ſlow and blundering; but, after the wheels are protruded, they are performed with great regularity, ſwiftneſs, and ſteadineſs. 19 Shows great quickneſs of ſenſation.

Notwithſtanding the minuteneſs of this animalcule, the microſcope generally diſcovers others in the ſame drop of water, compared with which the wheel-animal may be ſaid to be a whale. The tranſparency of its body, therefore, allows its internal parts to be ſeen, which cannot be perceived in the minuteſt animalcules on account of the ſmallneſs of their ſize. *a*, Is the appearance of the head; and though it is every where tranſparent, a ring or circle more particularly remarkable for its clearneſs is commonly perceived about the middle of the forehead, a little above the mouth. This, Mr Baker thinks, might juſtly be called the ſeat of the brain. Many veſſels which ſeem to take their origin from thence are diſcernible in the head, wherein ſome tranſparent fluid appears continually agitated by a kind of fluctuating motion. Fig. 15. 20 Deſcription of its internal parts.

The thorax, *b*, is joined to the head by a very ſhort neck, *c*, and appears to be about the ſixth part of the whole length of the animal. In the middle of the thorax is placed the heart, *d*, where its ſyſtole and diaſtole are plainly viſible. It is ſeen through the back of the inſect, ſhutting and opening alternately with great regularity and exactneſs. Its ſize is proportionable to the creature's bigneſs; and its ſhape, during the ſyſtole, is nearly circular, being compoſed ſeemingly of two ſemilunar parts, which then approach each other laterally, and form between them a roundiſh or horſe-ſhoe like figure, whoſe upper ſide is flat, and the under one convex. The diaſtole is performed by a ſeeming ſeparation, or opening, of theſe two ſemilunar parts, whereby the tranverſe diameter of the heart is very much enlarged. This ſeparation begins exactly in the middle

Animalcule.

middle of the lower part next the tail; and opens to ſuch a conſiderable width upwards, that the two parts, when at their utmoſt diſtenſion, ſeem only joined by an arched veſſel at their anterior end. The alternate motions of contraction and dilatation are performed with great ſtrength and vigour, in pretty much the ſame time as the pulſation of the arteries of a man in health. The motions of the heart are communicated to all the internal parts of the thorax; and ſeem to extend a great deal further; for a ſtrict examination diſcovers, at the ſame time, throughout the whole animal, contractions and dilatations going on, that are apparently correſpondent thereto. Theſe motions of the heart, however, are ſometimes ſuſpended, or imperceptible, for two or three minutes; after which they are renewed, and go on again with the ſame regularity as before. From the under part of the thorax proceeds a ſmall tranſparent horn repreſented at *a* fig. 11. and 12. It is never viſible but when the animal turns on its back or ſide.

The blood or circulating fluid of the wheel-animal is ſo abſolutely colourleſs, that the current of it through the veſſels is indiſtinguiſhable by glaſſes. A ſort of irregular agitation of ſome fluid is indeed perceived, which is perhaps a compound motion of currents running different ways, and forming ſuch an appearance, tho' no ſingle current is any where diſtinctly viſible.

Immediately below the thorax is another anular diviſion, *e*, joining upwards to the thorax, and downwards to the abdomen, the entrance whereof it ſerves occaſionally to enlarge or diminiſh. The abdomen, *f*, is by much the largeſt part of the animal, and contains the ſtomach and inteſtines. When the inſect is full of food, theſe bowels appear opaque and of a blood-red colour, extending quite through the belly and great part of the tail, and exhibiting a variety of contractions and dilatations. The belly is capable of ſtretching out greatly in length, or being ſhortened very much, and widening its diameter. It aſſumes many ſhapes, and becomes occaſionally a caſe for all the other parts of the body.

21 other kinds of wheel-animals.

Beſides the abovementioned one, there are found in the waters ſeveral other ſpecies of animals furniſhed with wheels, ſome of which appear to have a rotatory, and others a vibratory, motion. Fig. 25. repreſents a kind found in the ditch at Norwich, where the hair-like inſect is produced. They differ from the foregoing only in having very long tails. Fig. 26, 27, and 28, repreſent a ſpecies of wheel-animals, which are alſo covered with ſhells. The body of this ſpecies conſiſts of three parts, in like manner as the other; only the thorax and abdomen, in this, are not ſeparated by any gut, or intermediate veſſel, but are joined immediately together. The heart is plainly perceived, having a regular ſyſtole and diaſtole, at *a*, as in the former ſpecies. Theſe creatures occaſionally draw themſelves entirely within their ſhells; and the ſhell then appears terminated by ſix ſhort ſpikes on one ſide and two on the other.

22 Manner of producing their young ones.

The young ones of this ſpecies are carried in oval ſacculi, or integuments, faſtened externally to the lower part of their ſhells ſomewhere about the tail: theſe ſacculi are ſometimes opaque only at one end, and ſeemingly empty at the other; ſometimes they appear opaque in the middle, with a tranſparency all round, as in fig. 26. When a young one is about to burſt its integuments, the parent aſſiſts it greatly, by wagging its tail, and ſtriking the oval bag, ſo that the young one's head becomes as it were forced into the water, though the tail cannot be ſo ſoon diſengaged. In this condition the young one ſets its wheel a-going, and exerts all its endeavours to free itſelf from its confinement. (Fig. 28. *b*.) When it has got clear, it ſwims away, wagging its tail as the old one does, and leaving the integument adhering to the ſhell of the parent. The old one then uſes a number of efforts to get rid of this incumbrance, ſtriking againſt it with her tail; fixing the end of her tail upon it, and then darting her body forward; with ſeveral very odd motions not eaſy to be deſcribed. This kind of wheel-animals are great tormentors of the water-flea, *Pulex aquaticus arboreſcens* of Swammerdam; of which a figure is given from that author (Plate XXXIV.): fig. 2. ſhows the natural ſize of the flea; and fig. 1. ſhows it magnified, with ſome of the wheel-animals adhering to it. Theſe inſects are often found in great numbers in the ſame water: and when that is the caſe, it is not uncommon to diſcover five or ſix of theſe cruſtaceous wheel-animals faſtened by their tail to the ſhell or horns of the flea; cauſing it, ſeemingly, a vaſt deal of uneaſineſs; nor can they be driven away, or ſhaken off, by all the efforts the flea can uſe for that purpoſe.

23 Infeſt the Pulex Aquaticus.

24 Bell-flower animal.

5. *The bell-flower Animal, or Plumed Polype*. Theſe animalcules dwell in colonies together, from ten to fifteen (ſeldom falling ſhort of the former number, or exceeding the latter), in a ſlimy kind of mucilaginous or gelatinous caſe; which, out of the water, has no determined form, appearing like a little lump of ſlime; but, when expanded therein, has ſome reſemblance to the figure of a bell with its mouth upwards; and is uſually about half an inch long, and a quarter of an inch in diameter. Theſe bells, or colonies, are to be found adhering to the large leaves of duckweed, and other aquatic plants. They may be moſt eaſily diſcovered by letting a quantity of water, with duckweed in it, ſtand quietly for three or four hours in glaſs-veſſels in a window, or other place whence a ſtrong light comes: for then, if any are about the duckweed, they will be found, on careful inſpection, extending themſelves out of their caſes, and making an elegant appearance.

25 Where diſcovered.

The bell, or caſe, which theſe animals inhabit, being very tranſparent, all the motions of its inhabitants may be diſcerned through it diſtinctly. It ſeems divided internally into ſeveral apartments, or rather to contain ſeveral ſmaller ſacculi, each of which incloſes one of theſe animals. The openings at the tops of theſe ſacculi, are but juſt ſufficient to admit the creature's head and a ſmall part of its body to be thruſt out beyond them, the reſt remaining always in the caſe. It can, however, occaſionally retire into its caſe altogether; and never fails to do ſo when alarmed by any ſudden motion of the water, or of the veſſel which contains it.

26 Motions of the whole colony.

Beſides the particular and ſeparate motion which each of theſe creatures is able to exert within its own caſe, and independent of the reſt; the whole colony together has a power of altering the poſition of the bell; or even of removing it from one place to another; and hence this bell is ſometimes found ſtanding perfectly upright, as in fig. 29. and 33. and ſometimes bending the upper

part

part downwards, as in fig. 30. As these animalcules seem not to choose to stay together in societies whose number exceeds 15, when the colony happens to increase in number, the bell may be observed to split gradually, beginning from about the middle of the upper or anterior extremity, and proceeding downwards towards the bottom, as in fig. 32. till they at last separate entirely, and become two complete colonies independent of each other, one of which sometimes removes to another part of the vessel.

27 Description of an individual.

The arms of each individual of this colony are set round the head, to the number of 40, having each the figure of an Italic *ſ*, one of whose hooked ends is fastened to the head; and altogether, when expanded, compose a figure shaped somewhat like a horse's-shoe, convex on one side next the body, but gradually opening and turning outwards, so as to leave a considerable area within the outer extremities of the arms. When the arms are thus extended, the creature, by giving them a vibrating motion, can produce a current in the water, which brings the animalcules, or whatever other minute bodies are within the sphere of its action, with great velocity to its mouth, situated between the arms; where they are taken in if liked, or driven away by a contrary motion. The food is conveyed immediately from the mouth or opening between the arms, through a narrow neck, into a passage seemingly correspondent to the œsophagus in land-animals; down which it passes into the stomach, where it remains for some time, and then is voided upwards, in small round pellets, thro' a gut whose exit is near the neck. The body consists of three divisions; in the uppermost of which are contained all the abovementioned intestines, which are only to be discerned when the creature is full, at which time they become opaque. The other two divisions, which are probably fixed to the bell, seem to be of no other use than to give the creature a power of contraction and extension. The arms are not able to contract like those of the common polype; but, when the animal retires into its case, they are brought together in a close and curious order, so as to be easily drawn in. Though their general appearance when expanded is that of a cup whose base and top are of an horse-shoe form, they sometimes separate into four parts, and range themselves as in fig. 36. so as to resemble four separate plumes of feathers. Tho' their eyes cannot be discovered, yet Mr Baker thinks they have some perception of the light: for when kept in the dark, they always remain contracted; but on being exposed to the light of the sun or of a candle, they constantly extend their arms, and show evident signs of being pleased.

28 Seem to have a perception of light.

Fig. 29. represents one complete colony or bell standing erect, with all the animals out of their kingdom, and their arms extended, exhibiting altogether a very pretty appearance. *a* represents two oval bodies, supposed by Mr Baker to be eggs.

Fig. 30. shows all the creatures withdrawn into their cells, and the end of the bell hanging downwards.

Fig. 33. shows the bell erect, with only one of the animals coming out, in order to show its connection with the bell.

Fig. 34. shows the head and arms of a single polype closing together, and disposing themselves in order to be drawn into the ball.

Fig. 35. shows one complete animal greatly magnified, to show its several parts more distinctly; viz. *a*, the head, resembling a horse-shoe; *b b*, the arms seen from one side; *c*, The narrow neek; *d*, the œsophagus; *e*, the stomach; *f*, the gut or last intestine thro' which the food passes after being digested in the stomach; *g*, the anus, where the feces are discharged in little pellets; *h i*, that part of the bell which surrounds the body of the animal, and closes upon it when it retires down.

Fig. 37. the head and arms seen in front.

29 Globe-animal.

6. *The Globe-animal.* This animalcule, represented fig. 38. seems exactly globular, having no appearance of either head, tail, or fins. It moves in all directions, forwards or backwards, up or down, either rolling over and over like a bowl, spinning horizontally like a top, or gliding along smoothly without turning itself at all. Sometimes its motions are slow, at other times very swift; and when it pleases, it can turn round, as it were upon an axis, very nimbly, without removing out of its place. The whole body is transparent, except where the circular black spots are shown in the figure. Some of the animals have no spots, and others from one to seven. The surface of the whole body appears, in some, as if all over dotted with points; in others, as if granulated like shagreen: but their more general appearance is, as if beset thinly round with short moveable hairs or bristles, which probably are the instruments by which their motions are performed. These animalcules may be seen by the naked eye, but appear only like moving points.

30 Pipe-animal.

7. *The Pipe-animal.* These creatures are found on the coast of Norfolk, living in small tubes or cases of sandy matter, in such multitudes as to compose a mass sometimes of three feet in length. Fig. 39. shows a piece of such a congeries broke off, where *a a a a* represent the mouths or openings of the pipes wherein the little animals make their abode. Fig. 40. shows one single pipe, with its inhabitants, separated from the rest, and magnified nine or ten times in diameter. The pipe or case *b* is made of sand, intermixed here and there with minute shells, and all cemented together by a glutinous slime, probably issuing from the animal's own body *c*, which is composed of muscular ringlets like those of a worm, capable of great extension or contraction. The anterior end or head, *d*, is exceedingly beautiful, having round it a double row of little arms disposed in a very regular order, and probably capable of extension, in order to catch its food, and bring it to its mouth. Some of these tubes are found petrified, and constitute one species of syringoides.

31 Sometimes found petrified.

32 Insect with net-like arms.

8. *An insect with net-like arms.* The properties and shape of this little animal are very extraordinary. It is found only in cascades, where the water runs very swift. There these insects are found in clusters, standing erect on their tails; and resembling, when all together, the combs of bees at the time they are filled with their aureliæ. On being taken out of the water, they spin threads, by which they hang exactly in the same manner as the garden-spider. Fig. 42. shows one of these insects magnified. Its body appears curiously turned as on a lathe; and at the tail are three sharp spines, on which it raises itself, and stands upright in the water: but the most curious apparatus is about its head, where it is furnished with two instruments like fans or nets, which serve to provide its food. These it frequently spreads out and draws in again; and when drawn up they

are

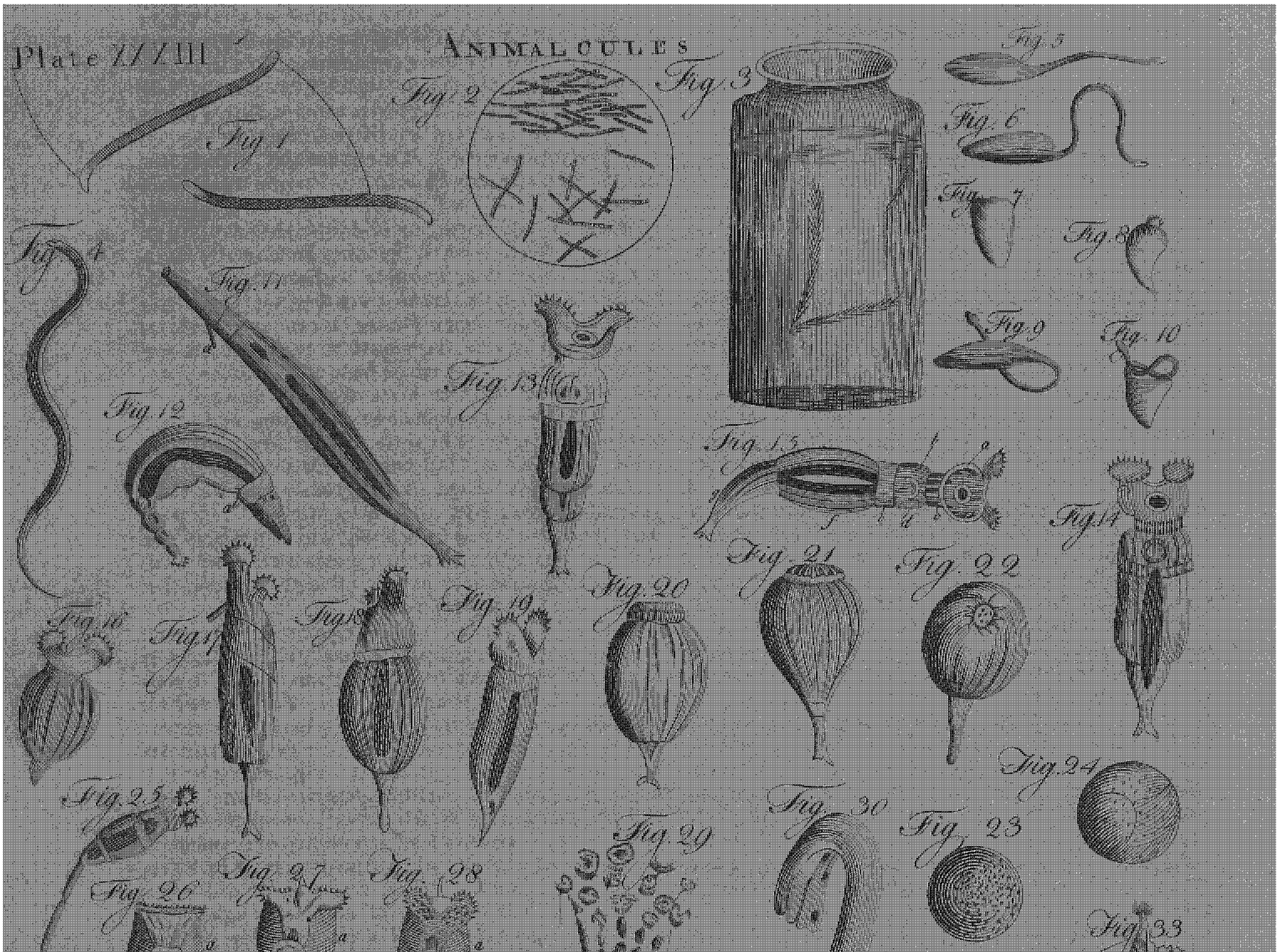


Plate XXXIII
ANIMALCULES
Fig. 1
Fig. 2
Fig. 3
Fig. 4
Fig. 5
Fig. 6
Fig. 7
Fig. 8
Fig. 9
Fig. 10
Fig. 11
Fig. 12
Fig. 13
Fig. 14
Fig. 15
Fig. 16
Fig. 17
Fig. 18
Fig. 19
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Fig. 30
Fig. 31
Fig. 32
Fig. 33
Fig. 34
Fig. 35
Fig. 36
Fig. 37
Fig. 38
Fig. 39
Fig. 40
Fig. 41
Fig. 42
Fig. 43
Scot Philad^a

Animalcule.

are folded together with the utmoſt nicety and exactneſs, ſo as to be indiſcernible when brought cloſe to the body. At the bottom of of theſe fans a couple of claws are faſtened to the lower part of the head, which, every time the nets are drawn in, conduct to the mouth of the animal whatever is taken in them. When the creature doth not employ its nets, it thruſts out a pair of ſharp horns, as in fig. 41. where the inſect is ſhown magnified about 400 times.

Some of theſe creatures being kept with water in a vial, moſt of them died in two days; and the reſt, having ſpun themſelves tranſparent caſes (which were faſtened either to the ſides of the glaſs, or to pieces of graſs put into it), ſeemed to be changed into a kind of chryſalis: but before taking this form, they appeared as in fig. 43. which ſhape they likewiſe aſſumed when weary with catching their food, or when lying in wait for it. None of them lived above three days;

33 Surpriſing property of ſpoiling water.

and though freſh water was given them two or three times a-day, yet in a few hours it would ſtink to a degree ſcarce conceivable, and that too at ſeveral yards diſtance, though, in proportion to the water, all the included inſects were not more than as 1 to 1,150,000. This makes it probable, that it is neceſſary for them to live in a rapid ſtream, leſt they ſhould be poiſoned by the effluvia iſſuing from their own bodies, as no doubt they were in the vial.

34 An aquatic worm.

9. *A curious aquatic worm.* This animalcule is ſhown, magnified, at fig. 31. It is found in ditch-water; and is of various ſizes, from $\frac{1}{40}$ to $\frac{1}{2}$ an inch in length. About the head it has ſomewhat of a yellowiſh colour; but all the reſt of the body is perfectly colourleſs and tranſparent, except the inteſtines, which are conſiderably opaque, and diſpoſed as in the figure. Along its ſides are ſeveral papillæ, with long hairs growing from them: it has two black eyes, and is very

35 Its horn or proboſcis.

nimble. But the moſt remarkable thing in this creature is a long horn or proboſcis; which, in the large ones, may be ſeen with the naked eye, if the water is clear, and is ſometimes $\frac{1}{10}$ of an inch in length: this it waves to and fro as it moves in the water, or creeps up the ſide of the glaſs; but it is not known whether it is hollow, or of what uſe it is to the creature itſelf.

36 Spermatic animals, when diſcovered.

10. *Spermatic Animals*, and *Animalcula Infuſoria*. The diſcovery of living animalcules in the ſemen of moſt animals is claimed by Mr Liewenhoeck and Mr Nicholas Hartſoeker; who both ſay they publiſhed it about the end of the year 1677 or beginning of 1678: but Mr Liewenhoeck having given the moſt particular deſcription of, and made by far the greateſt number of experiments concerning them, the diſcovery is commonly attributed to him.

37 General appearance the ſame in every animal.

According to this naturaliſt, theſe animalcules are found in the ſemen maſculinum of every kind of animal; but their general appearance is very much the ſame, nor doth their ſize differ in proportion to the bulk of the animal to which they belong. The bodies of all of them ſeem to be of an oblong oval form, with long tapering ſlender tails iſſuing from them; and as by this ſhape they reſemble *tadpoles*, they have been frequently called by that name; tho' the tails of them, in proportion to their bodies, are much longer than the tails of tadpoles are: and it is obſervable, that the animalcules in the ſemen of fiſhes have tails much longer and more ſlender than the tails of thoſe in other animals; inſomuch, that the extremity of them is not to be diſcerned without the beſt glaſſes, and the utmoſt attention. Fig. 21. N° 1, 2, 3, 4, repreſent the ſpermatic animalcula of the rabbit; and N° 5, 6, 7, 8, thoſe of a dog; according to Mr Liewenhoeck.

Animalcule. Plate, XXXIV.

38 Inconceivable numbers and minuteneſs.

The numbers of theſe animalcula are inconceivable. On viewing with a microſcope the milt or ſemen maſculinum of a living cod-fiſh, innumerable multitudes of animalcules were found therein, of ſuch a diminutive ſize, that he ſuppoſed at leaſt 10,000 of them capable of being contained in the bulk of a grain of ſand; whence he concludes, that the milt of this ſingle fiſh contained more living animalcules than there are to be found people living in the whole world. To find the comparative ſize of theſe animalcules, Mr Liewenhoeck placed an hair of his head near them; which hair, through his microſcope, appeared an inch in breadth; and he was ſatisfied, that at leaſt 60 ſuch animalcules could eaſily lie within that diameter; whence, their bodies being ſpherical, it follows, that 216,000 of them are but equal to a globe whoſe diameter is the breadth of a hair. He obſerved, that when the water wherewith he had diluted the ſemen of a cod-fiſh was exhaled, the little bodies of the animalcules burſt in pieces; which did not happen to thoſe in the ſemen of a ram: and this he imputes to the greater firmneſs and conſiſtency of the latter, as the fleſh of a land-animal is more compact than fiſh.

39 Are continually in motion.

Theſe animalcules appear to be very vigorous, and tenacious of life; for they may be obſerved to move long after the animal from which they are taken is dead. They have this peculiarity alſo, that they are continually in motion, without the leaſt reſt or intermiſſion, provided there is fluid ſufficient for them to ſwim about in. Theſe animalcula are peculiar to the ſemen; nothing that has the leaſt token of life being diſcovered, by the beſt glaſſes, either in the blood, ſpittle, urine, gall, or chyle. Great numbers, however, are to be found in the whitiſh matter that ſticks between the teeth; ſome of which are of an oval figure, and others reſemble eels.

40 Animalcula Infuſoria.

The *Animalcula Infuſoria*, take their name from their being found in all kinds either of vegetable or animal infuſions. Indeed, there is ſcarce any kind of water, unleſs impregnated with ſome mineral ſubſtance, but what will diſcover living creatures.—Mr Liewenhoeck

41 Mr Liewenhoeck's account of animalcules in rain-water.

ſays, that at firſt he could diſcern no living creatures in rain-water; but after ſtanding ſome days, he diſcovered innumerable animalcules, many thouſands of times leſs than a grain of ſand, and in proportion to a mite as a bee is to a horſe.—In other rain-water, which had likewiſe ſtood ſome time, he found the ſmalleſt ſort he had ever ſeen; and, in a few days more, met with others eight times as big as theſe, and almoſt round.—In another quantity of rain-water, that had been expoſed like the former, he diſcovered a kind of animalcules with two little horns in continual motion. The ſpace between the horns was flat, though the body was roundiſh, but tapering a little towards the end; where a tail appeared, four times as long as the body, and the thickneſs of a ſpider's web. He obſerved ſeveral hundreds of theſe within the ſpace a grain of ſand would occupy. If they happened on the leaſt filament or ſtring, they were entangled in it; and then would extend their bodies into an oblong round, and ſtruggle hard to diſengage their tails. He obſerved a ſecond

ſort

ſort of an oval figure, and imagined the head to ſtand at the ſharpeſt end. The body was flat, with ſeveral ſmall feet moving exceeding quick, but not diſcernible without a great deal of attention. Sometimes they changed their ſhape into a perfect round, eſpecially when the water began to dry away. He met alſo with a third ſort, twice as long as broad, and eight times ſmaller than the firſt: yet in theſe he diſcerned little feet; whereby they moved very nimbly. He perceived likewiſe a fourth ſort, a thouſand times ſmaller than a louſe's eye, and which exceeded all the reſt in briſkneſs: he found theſe turning themſelves round, as it were upon a point, with the celerity of a top. And he ſays, there were ſeveral other ſorts.

42 Surpriſing production of theſe animalcules.

The production of *animalcula infuſoria* is very ſurpriſing. In four hours time, an infuſion of cantharides has produced animalcula leſs than even the tails of the ſpermatic animals we have already deſcribed. Neither do they ſeem to be ſubject to the fate of other animals; but, ſeveral kinds of them at leaſt, by dividing themſelves in two, to enjoy a ſort of immortality. Nor do the common methods by which other animals are deſtroyed, ſeem to be effectual for deſtroying their vital principle. Hot mutton-gravy, ſecured in a phial with a cork, and afterwards ſet among hot aſhes to deſtroy as effectually as poſſible every living creature that could be ſuppoſed to exiſt in it, has nevertheleſs been found ſwarming with animalcules after ſtanding a few days.

43 Mr Ellis's account of animalcules from infuſion of potatoes.

In the Philoſophical Tranſactions, Vol. LIX. we have the following curious account, given us by Mr Ellis, of animalcules produced from an infuſion of potatoes and of hempſeed.

"On the 25th of May 1768, Fahrenheit's thermometer 70°, I boiled a potatoe in the New-River water till it was reduced to a mealy conſiſtence. I put part of it, with an equal proportion of the boiling liquor, into a cylindrical glaſs-veſſel that held ſomething leſs than half a wine-pint, and covered cloſe immediately with a glaſs-cover. At the ſame time, I ſliced an unboiled potatoe; and, as near as I could judge, put the ſame quantity into a glaſs-veſſel of the ſame kind; with the ſame proportion of New-River water not boiled; and covered it with a glaſs-cover; and placed both veſſels cloſe to each other.

"On the 26th of May, 24 hours afterwards, I examined a ſmall drop of each, by the firſt magnifier of Wilſon's microſcope, whoſe focal diſtance is reckoned at $\frac{1}{50}$ part of an inch; and, to my amazement, they were both full of animalcula of a linear ſhape, very diſtinguiſhable, moving to and fro with great celerity; ſo that there appeared to be more particles of animal than vegetable life in each drop.

"This experiment I have repeatedly tried, and always found it to ſucceed in proportion to the heat of the circumambient air; ſo that even in winter, if the liquors are kept properly warm, at leaſt in two or three days the experiment will ſucceed.

"What I have obſerved are infinitely ſmaller than ſpermatic animals, and of a very different ſhape: the truth of which every accurate obſerver will ſoon be convinced of, whoſe curioſity may lead him to compare them; and I am perſuaded he will find they are no way akin.

"At preſent I ſhall paſs over many other curious obſervations, which I have made on two years experiments, in order to proceed to the explaining a hint which I received laſt January from Mr De Sauſſure of Geneva, when he was here; which is, that he found one kind of theſe animalcula infuſoria that increaſe by dividing acroſs into nearly two equal parts.

"I had often ſeen this appearance in various ſpecies a year or two ago, as I found upon looking over the minutes I had taken when I made any new obſervation; but always ſuppoſed the animal, when in this ſtate, to be in coition.

"Not hearing, till after M. De Sauſſure left this kingdom, from what infuſion he had made his obſervation; his friend Dr de la Roche of Geneva informed me, the latter end of February laſt, that it was from hempſeed.

"I Immediately procured hempſeed from different ſeedſmen in diſtant parts of the town. Some of it I put into New-River water, ſome into diſtilled water, and ſome I put into very hard pump-water. The reſult was, that in proportion to the heat of the weather, or the warmth in which they were kept, there was an appearance of millions of minute animalcula in all the infuſions; and, ſome time after, ſome oval ones made their appearance, as at fig. 3. *b c*. Theſe were much larger than the firſt, which ſtill continued; theſe wriggled to and fro in an undulatory motion, turning themſelves round very quick all the time that they moved forwards. 44 From an infuſion of hempſeed.

I was very attentive to ſee theſe animals divide themſelves; and at laſt I perceived a few of the appearance of fig. 3. *a*, as it is repreſented by the firſt magnifier of Wilſon's microſcope; but I am ſo well convinced by experience that they would ſeparate, that I did not wait to ſee the operation: however, as the following ſketches, which I have drawn from five other ſpecies, will very fully explain this extraordinary phenomenon, there will be no difficulty in conceiving the manner of the firſt. See fig. 4, 5, 6, 7, 8. 45 Divide themſelves in two.

"The proportion of the number of theſe animals which I have obſerved to divide in this manner, to the reſt, is ſcarce 1 to 50; ſo that it appears rather to ariſe from hurts received by ſome few animalcula among the many, than to be the natural manner in which theſe kinds of animals multiply; eſpecially if we conſider the infinite quantity of young ones which are viſible to us through the tranſparent ſkins of their bodies, and even the young ones that are viſible in thoſe young ones while in the body of the old ones.

"But nothing more plainly ſhows them to be zoophytes than this circumſtance, That when, by accident, the extremity of their bodies has been ſhrivelled for want of a ſupply of freſh water, the applying more freſh water has given motion to the part of the animal that was ſtill alive; by which means, this ſhapeleſs figure has continued to live and ſwim to and fro all the time it was ſupplied with freſh water.

"I cannot finiſh this part of my remarks on theſe animals, without obſerving, that the excellent Linnæus has joined the *beroë* with the *volvox*, one of the animalcula infuſoria. The beroë is a marine animal, found on our coaſts; of a gelatinous tranſparent nature, and of an oval or ſpherical form, about half an inch to an inch diameter; divided like a melon into longitudinal ribs, each of which is furniſhed with rows of minute fins; by means of which, this animal, like the animalcula infuſoria, can ſwim in all directions with great ſwiftneſs. 46 Beroë deſcribed.

Animalcule.

swiftness. In the same manner I have seen most of those minute animals move so swift that we could not account for it, without supposing such a provision in nature, which is really true, but cannot be seen till the animals grow faint for want of water; then, if we attend, we may with good glasses plainly discover them.

47
Method of discovering the fins of animalcules.

"I have lately found out, by mere accident, a method to make their fins appear very distinctly, especially in the larger kind of animalcula, which are common to most vegetable infusions; such as the terebella. This has a longish body, with a cavity or groove at one end, like a gimlet: by applying, then, a small stalk of the horse-shoe geranium (or geranium zonale of Linnæus), fresh broken, to a drop of water in which these animalcula are swimming, we shall find that they will become torpid instantly; contracting themselves into an oblong oval shape, with their fins extended like so many bristles all round their bodies. The fins are in length about half the diameter of the middle of their bodies. Before I discovered this expedient, I tried to kill them by different kinds of salts and spirits; but though they were destroyed by this means, their fins were so contracted, that I could not distinguish them in the least. After lying in this state of torpidity for two or three minutes, if a drop of clean water is applied to them, they will recover their shape, and swim about immediately, rendering their fins again invisible."

Fig. 3, 4, 5, 6, 7, 8. represent different species of animalcula infusoria, mentioned by Mr Ellis as belonging to the genus of volvox of Linnæus.

Fig. 3. represents the volvox ovalis, or egg-shaped volvox; at (b) and (c) it is expressed in its natural shape; at (a) the manner in which it becomes two animals, by separating across the middle. This was found in the infusion of hempseed; but is found in other vegetable infusions, particularly that of tea-seed.

Fig. 4. is the volvox torquilla, or wryneck. At (a) is represented its divided state; at (b) and (c) its natural state: this is common to most vegetable infusions, as is the following.

Fig. 5. is the volvox volutans, or the roller. At (a) the animal is separated, and becomes two distinct beings, each swimming about and providing for itself; this is often the prey of another species of this genus, especially while it is weak by this separation, not being so active for some time till it can recover itself. At (c) the animal appears to be hurt on one side; this impression in a little time is succeeded by another in the opposite side, as at (b), which soon occasions a division. At (d) is the side-view, and at (e) the front-view, of the natural shape of the animal.

Fig. 6. is the volvox oniscus, or wood-louse. At (a) is the natural shape of it, as it appears full of little hairs both at the head and tail; with those at the head, it whirls the water about to draw its prey to it; the feet, which are many, are very visible, but remarkably so in a side-view at (d). At (b) it is represented beginning to divide; and at (c) the animals are ready to part: in this state, as if in exquisite pain, they swim round and round, and to and fro, with uncommon velocity, violently agitated till they get asunder. This was found in an infusion of different kinds of pine-branches.

Fig. 7. is the volvox terebella, or the gimlet. This is one of the largest of the kind, and is very visible to the naked eye. It moves along swiftly, turning itself round as it swims, just as if boring its way. (a) and (b) are two views of its natural shape, (c) shows the manner of its dividing. When they are separated, the lower animal rolls very awkwardly along, till it gets a groove in the upper part. (d) represents one of them lying torpid, by means of the juice of the horse-shoe geranium, with its fins extended. This animal is found in many infusions, particularly of grass or corn.

Fig. 8. is the volvox vorax, or glutton. This animal was found in an infusion of the Tartarian pine; it varies its shape very much, contracting and extending its proboscis, turning it to and fro, in various directions, as at a, b, c, d, e. It opens its proboscis underneath the extremity, when it seizes its prey. The less active animals, that have lately been divided, such as those at fig. 3. (a), and at fig. 4. (a), serve it as food, when they come in its way: these it swallows down instantly, as it is represented at fig. 8. h and i. At (f) it is ready to divide, and at (g) it is divided; where the hinder-part of the divided animal has got a proboscis or beak, to procure nourishment for itself, and soon becomes a distinct being from the fore-part.

Thus we have given as full an account as our limits would admit, of the most curious kinds of animalcules that have hitherto been observed. We cannot, however, dismiss this subject, without taking notice of some of the most remarkable hypotheses which have been formed concerning their nature and origin.

48
Doctrine of equivocal generation exploded.

Before the invention of microscopes, the doctrine of equivocal generation, both with regard to animals and plants of some kinds, was universally received: but this instrument soon convinced every intelligent person, that those plants which formerly were supposed to be produced by equivocal generation arose from seeds, and the animals, in like manner, from a male and female. But as the microscope threw light upon one part of nature, it left another involved in darkness; for the origin of the animalcula infusoria, or of the spermatic animals already mentioned, remains as yet as much unknown as that of many other kinds was when the doctrine of equivocal generation reigned in full force.

49
Supposed discovery concerning generation.

The discovery of spermatic animalcules was thought to throw some light on the mysterious affair of generation itself, and these minute creatures were imagined to be each of them individuals of the same species with the parent. Here the infinite number of these animalcules was an objection, and the difficulty remained as great as before; for, as every one of these animalcules behoved to be produced from a male and female, to explain their origin by animalcular generation in the same manner, was only explaining generation by itself.

This hypothesis, therefore, having proved unsatisfactory, others have been invented. M. Buffon, particularly, hath invented one, by which he at once annihilates the whole animalcular world; and in this he hath been followed by several very ingenious philosophers. For a particular account of this, so far as it concerns generation, we must refer to that article; but as he gives such a particular account of his having examined the human semen, that we cannot doubt of his accuracy, we shall here contrast his account with that of Mr Liewenhoeck already mentioned.

Animalcule.

50 M. Buffon's experiments on the human semen.

Having procured the seminal vessels of a man who died a violent death, he extracted all the liquor from them while they were still warm; and having examined a drop of it with a double microscope, it had the appearance fig. 9. Large filaments appeared, which in some places spread out into branches, and in others intermingled with one another. These filaments clearly appeared to be agitated by an internal undulatory motion, like hollow tubes, which contained some moving substance. He saw distinctly this appearance changed for that fig. 10. Two of these filaments, which were joined longitudinally, gradually separated from each other in the middle, alternately approaching and receding, like two tense cords fixed by the ends, and drawn asunder in the middle. These filaments were composed of globules that touched one another, and resembled a chaplet of beads. After this, he observed the filaments swelled in several places, and perceived small globular bodies issue from the swelled parts, which had a vibratory motion like a pendulum. These small bodies were attached to the filaments by small threads, which gradually lengthened as the bodies moved. At last, the small bodies detached themselves entirely from the filaments, drawing after them the small thread, which looked like a tail. When a drop of the seminal liquor was diluted, these small bodies moved in all directions very briskly; and had he not seen them separate themselves from the filaments, he would, he says, have thought them to be animals. The seminal matter was at first too thick, but gradually became more fluid; and, in proportion as its fluidity increased, the filaments disappeared, but the small bodies became exceedingly numerous. Each of them had a long thread or tail attached to it, from which it evidently endeavoured to get free. Their progressive motion was extremely slow, during which they vibrated to the right and left, and at each vibration they had a rolling unsteady motion, in a vertical direction.

At the end of two or three hours, the seminal matter becoming still more fluid, a greater number of these moving bodies appeared. They were then more free of incumbrances; their tails were shorter; their progressive motion was more direct, and their horizontal motion greatly diminished. In five or six hours, the liquor had acquired almost all the fluidity it could acquire, without being decomposed. Most of the small bodies were now disengaged from their threads; their figure was oval. They moved forward with considerable quickness, and, by their irregular motions backward and forward, they had now more than ever the appearance of animals. Those that had tails adhering to them, seemed to have less vivacity than the others; and of those that had no tails, some altered both their figure and their size. In twelve hours, the liquor had deposited at the bottom of the vial a kind of ash-coloured gelatinous substance, and the fluid at top was almost as transparent as water. The little bodies being now entirely freed from their threads, moved with great agility, and some of them turned round their centres. They also often changed their figures, from oval becoming round, and often breaking into smaller ones. Their activity always increased as their size diminished. In 24 hours, the liquor had deposited a greater quantity of gelatinous matter, which, being with some difficulty diluted in water, exhibited an appearance somewhat resembling lace. In the clear semen itself only a few small bodies were now seen moving; next day, these were still farther diminished; and after this nothing was to be seen but globules, without the least appearance of motion. Most of the abovementioned appearances are shown fig. 10, 11, 12, 13, 14, 15, 16. Fig. 17. and 18. represent an appearance of the globules in another experiment, in which they arranged themselves in troops, and passed very quickly over the field of the microscope. In this experiment they were found to proceed from a small quantity of gelatinous mucilage.

From these experiments, M. Buffon concludes, that what have been called spermatic animals, are not creatures really endowed with life, but something proper to compose a living creature; and he distinguishes them by the name of *organic particles*. The same individual kinds of animals he declares he has found in the fluids separated from the ovaria of females; and for the truth of this appeals to the testimony of Mr Needham, who was an eye witness of his experiments. He also brings an additional proof of his doctrine from Mr Needham's observations on the milt of the *calmar*, a species of cuttle-fish. Here the spermatic animals, at least what have the only appearance of life, are vastly larger than in any other creature, so as to be plainly visible to the naked eye. When magnified, they appear as at fig. 19. and 20. *a*. Their first appearance is at fig. 19. *a* and *b*, when they resemble springs inclosed in a transparent case. These springs were equally perfect at first as afterwards; only in time they contracted themselves, and became like a kind of screw. The head of the case is a species of valve which opens outward, and through which every thing within may be forced out. It contains, besides, another valve *b*, a little barrel *c*, and a spongy substance *d e*. Thus the whole machine consists of an outer transparent cartilaginous case *a*, the superior extremity of which is terminated by a round head formed by the case itself, and performs the office of a valve. This external case contains a transparent tube; which includes the spring, a piston or valve, a little barrel, and a spongy substance. The screw occupies the superior part of the tube and case, the piston and barrel are situated in the middle, and the spongy substance occupies the inferior part. These machines pump the liquor of the milt; the spongy substance is full of this liquor; and before the animal spawns, the whole milt is only a congeries of these bodies which have sucked up all the liquor of it. Whenever these small machines are taken out of the body of the animal, and put in water, or exposed to the air, they begin to act, as represented fig. 19. and 20; the spring mounts up, and is followed by the piston, the barrel, and the spongy substance which contains the liquor: and, as soon as the spring and the tube in which it is contained begin to issue out of the case, the spring plaits, and the whole internal apparatus moves, till the spring, the piston, and the barrel, have entirely escaped from the case. When this is effected, all the rest instantly follow, and the milty liquor which had been pumped in, and confined in the spongy substance, runs out through the barrel.

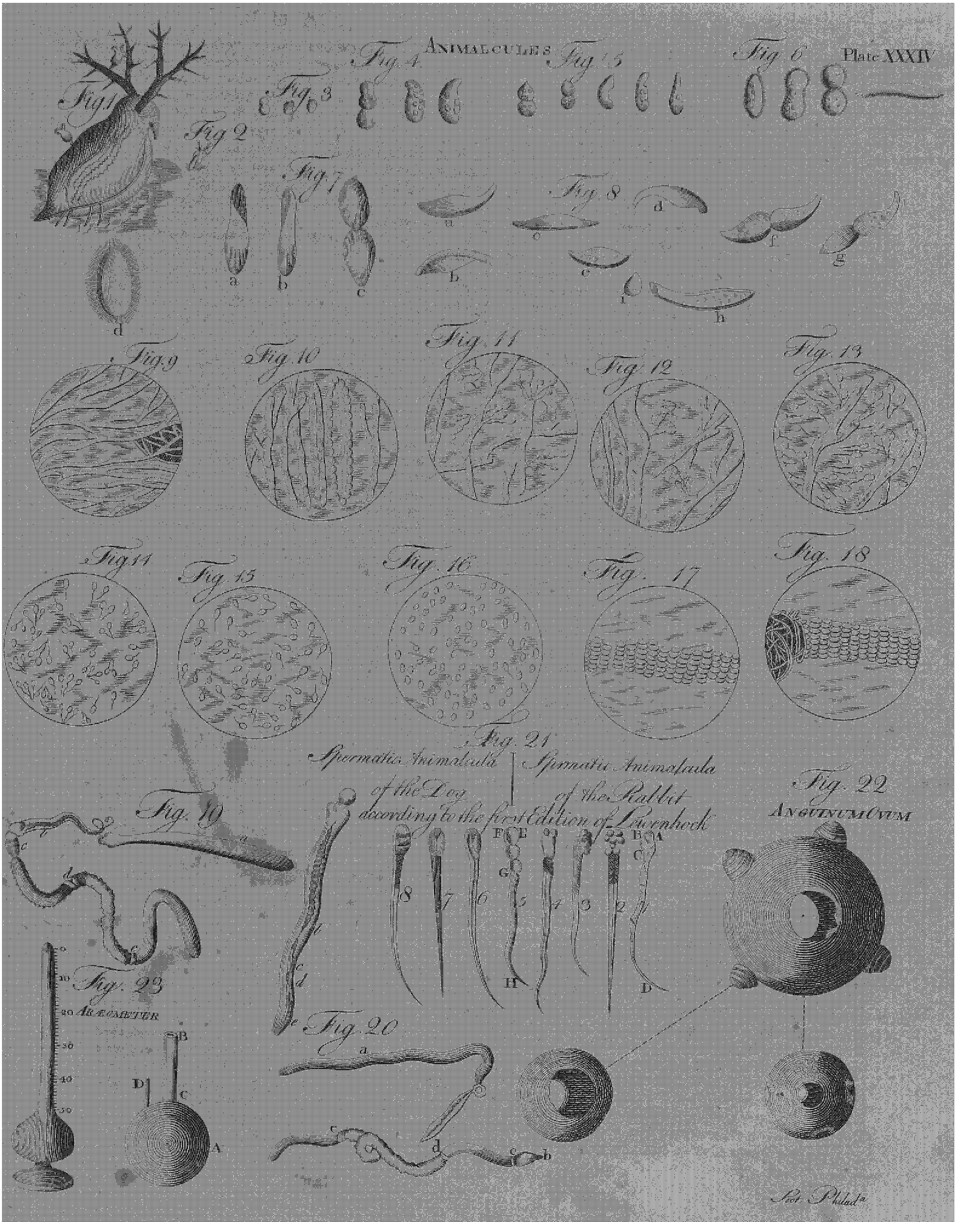
51 Needham's experiments on the milt of the calmar.

Fig. 20.

52 Conclusion against the existence of animalcules

According to this account, the milt of the calmar contains no animalcules; and therefore we may from analogy conclude, that the small moving bodies which are to be seen in the semen of other animals, are not

really


Animalcules
Plate XXXIV
Fig 1
Fig 2
Fig 3
Fig 4
Fig 5
Fig 6
Fig 7
Fig 8
Fig 9
Fig 10
Fig 11
Fig 12
Fig 13
Fig 14
Fig 15
Fig 16
Fig 17
Fig 18
Fig 19
Fig 20
Fig 21
Spermatic Animalcula of the Dog
Spermatic Animalcula of the Rabbit
according to the first Edition of Lewenhoek
Fig 22
Anguinum Ovum
Fig 23
Aræometer
Scot Philad.a

Animalcule. really creatures endowed with life. M. Buffon extends the analogy ſtill further; and concludes, that all the moving bodies which are to be found in the infuſions either of animal or vegetable ſubſtances are of a ſimilar nature. "To diſcover (ſays he) whether all the parts of animals, and all the ſeeds of plants, contained moving organic particles, I made infuſions of the fleſh of different animals, and of the ſeeds of more than 20 different ſpecies of vegetables; and after remaining ſome days in cloſe glaſſes, I had the pleaſure of ſeeing organic moving particles in all of them. In ſome they appeared ſooner, in others later; ſome preſerved their motions for months, and others ſoon loſt it. Some at firſt produced large moving globules reſembling animals, which changed their figure, ſplit, and became gradually ſmaller. Others produced only ſmall globules, whoſe motions were extremely rapid; and others produced filaments, which grew longer, ſeemed to vegetate, and then ſwelled and poured forth torrents of moving globules."

53 Baron Munchanſen's theory.

54 Diſproved by Mr Ellis.

This laſt obſervation gave riſe to a new ſyſtem. Baron Munchanſen, perceiving that the laſt mentioned moving globules, after moving for ſome time, began again to vegetate, concluded that they were firſt animals and then plants.—This ſtrange hypotheſis Mr Ellis has overturned in the paper already quoted; in which he aſſerts, that they are no other than the ſeeds of that genus of fungi called *mucor* or *mouldineſs*, and that their motion is owing to numbers of minute animalcules attacking them for food. "Having (ſays he), at the requeſt of Dr Linnæus, made ſeveral experiments on the infuſion of muſhrooms in water, in order to prove the theory of Baron Munchanſen, that their ſeeds are firſt animals, and then plants (which he takes notice of in his ſyſtem of Nature, p. 1326, under the genus of chaos, by the name of *chaos fungorum ſeminum*), it appeared evidently, that the ſeeds were put into motion by very minute animalcules, which proceeded from the putrefaction of the muſhroom: for, by pecking at theſe ſeeds, which are reddiſh, light, round bodies, they moved them about with great agility in a variety of directions; while the little animals themſelves were ſcarce viſible, till the food they had eaten had diſcovered them. The ſatisfaction I received from clearing up this point, led me into many other curious and intereſting experiments.

"The ingenious Mr Needham ſuppoſes theſe little tranſparent ramified filaments, and jointed or coralloid bodies, which the microſcope diſcovers to us on the ſurface of moſt animal and vegetable infuſions when they become putrid, to be zoophytes, or branched animals: but to me they appear, after a careful ſcrutiny with the beſt glaſſes, to be of that genus of fungi called *mucor*, or *mouldineſs*; many of which Michelius has figured, and Linnæus has accurately deſcribed.

"Their vegetation is ſo amazingly quick, that they may be perceived in the microſcope even to grow and feed under the eye of the obſerver.

"Mr Needham has pointed out to us a ſpecies that is very remarkable for its parts of fructification. (See Philoſophical Tranſactions, vol. xlv. tab. 5. fig. 3. a, A.). This, he ſays, proceeded from an infuſion of bruiſed wheat.

"I have ſeen the ſame ſpecies ariſe from the body of a dead fly, which was become putrid by lying floating for ſome time in a glaſs of water, where ſome flowers had been in the month of Auguſt 1768. This ſpecies of mucor ſends forth a maſs of tranſparent filamentous roots; from whence ariſe hollow ſtems, that ſupport little oblong oval ſeed-veſſels, with a hole on the top of each. From theſe I could plainly ſee minute globular ſeeds iſſue forth in great abundance with an elaſtic force, and turn about in the water as if they were animated.

"Continuing to view them with ſome attention, I could juſt diſcover that the putrid water which ſurrounded them was full of the minuteſt animalcula; and that theſe little creatures began to attack the ſeeds of the mucor for food, as I have obſerved before in the experiment on the ſeeds of the larger kind of fungi or muſhrooms. This new motion continued the appearance of their being alive for ſome time longer: but, ſoon after many of them aroſe to the ſurface of the water, remaining there without motion; and a ſucceſſion of them afterwards coming up, they united together in little thin maſſes, and floated to the edge of the water, remaining there quite inactive during the time of obſervation.

As this diſcovery cleared up many doubts which I had received from reading Mr Needham's learned diſſertation, I put into the glaſs ſeveral other dead flies, by which means this ſpecies of mucor was propagated ſo plentifully, as to give me an opportunity of frequently trying the ſame experiment to my full ſatisfaction.

"Laſtly, Theſe jointed coralloid bodies, which Mr Needham calls *chaplets* and *pearl necklaces*, I have ſeen frequently very diſtinctly. Theſe appear not only on an infuſion of bruiſed wheat when it becomes putrid, but on moſt other bodies when then they throw up a viſcid ſcum and are in a ſtate of putrefaction. Theſe, then, are evidently no more than the moſt common mucor, the ſeeds of which are every where floating in the air; and bodies in this ſtate afford them a natural proper ſoil to grow upon. Here they ſend downwards their fine tranſparent ramified roots into the moiſture which they float upon; and from the upper part of the ſcum, their jointed coralloid branches riſe full of ſeed into little grove-like figures. When a ſmall portion of theſe branches and ſeeds are put into a drop of the ſame putrid water upon which the ſcum floats, many of theſe millions of little animalcula with which it abounds, immediately ſeize them as food, and turn them about with a variety of motions, as in the experiments on the ſeeds of the common muſhrooms, either ſingly, or two or three ſeeds connected together; anſwering exactly to Mr Needham's deſcription, but evidently without any motion of their own, and conſequently not animated."

55 M. Buffon's opinion of different kinds of naimalcules.

M. Buffon, however, is not content with denying life only to thoſe beings where the ſigns of it are the moſt equivocal; but includes in the ſame rank of organic particles, almoſt every animal too ſmall to be diſcovered by the naked eye, and even ſome of thoſe whoſe motions are evidently perceptible to the eye. "Almoſt all microſcopic animals (ſays he), are of the ſame nature with the moving bodies in the ſeminal fluids and infuſions of animal and vegetable ſubſtances. The eels in paſte, in vinegar, &c. are all of the ſame nature, and derived from the ſame origin. There are, perhaps, as many beings that either live or vegetate, produced by a fortuitous aſſemblage of organic particles,

Animalcule.

cles, as by a conſtant and ſucceſſive generation. Some of them, as thoſe of the calmar, are only a kind of machines, which, though exceedingly ſimple, are very active. Others, as the ſpermatic animalcules, ſeem to imitate the movements of animals. Others reſemble vegetables in their manner of growth and extenſion. There are others, as thoſe of blighted wheat, which at pleaſure can be made alternately either to live or die, and it is difficult to know to what they ſhould be compared. There are ſtill others, and in great numbers, which are at firſt a kind of animals, then become a ſpecies of vegetables, and again return alternately to their vegetable ſtate. The eels in paſte have no other origin than the union of the organic particles of the moſt eſſential part of the grain. The firſt eels that appear are certainly not produced by other eels; but though they are not propagated themſelves they fail not to engender other living eels. By cutting them with the point of a lancet, we diſcover ſmaller eels iſſuing in great numbers out of their bodies. The body of this animal ſeems to be only a ſheath or ſac, containing a multitude of ſmaller animals, which perhaps are other ſheaths of the ſame kind, in which the organic matter is aſſimilated into the form of eels."

56 His reaſoning inconcluſive.

Though we can by no means pretend to account for the appearance of theſe animalcules, yet we cannot help obſerving, that our ignorance of the cauſe of any phenomenon is no argument againſt its exiſtence. Though we are not able to account in a ſatisfactory manner for the origin of the native Americans, we ſuppoſe M. Buffon himſelf would reckon it abſurd to maintain that the Spaniards on their arrival there found only *organic particles* moving about in diſorder. The caſe is the very ſame with the eels in paſte. They are exceedingly minute in compariſon with us; but with the ſolar microſcope, Mr Baker has made them aſſume a more reſpectable appearance, ſo as to have a diameter of an inch and an half, or two inches, and a length proportionable. They ſwam up and down very briſkly; the motion of their inteſtines was plainly viſible; when the water dried up, they died with apparent agonies, and their mouths gaped very wide. Were we to find a creature of the ſize of this magnified eel, gaſping in a place where water had lately been, we certainly would never conclude it to be an *organic particle*, or a fortuitous aſſemblage of them; but a fiſh. Why then ſhould we conclude otherwiſe with regard to the eel while in its natural ſtate, than that it is a little fiſh? In reaſoning on this ſubject, we ought always to remember, that, however eſſential the diſtinction of bodies into great and ſmall may appear to us they are not ſo to the Deity; with whom, as Mr Baker well expreſſes himſelf, "an atom is as a world, and a world but as an atom."— Were the Deity to exert his power for a little, and give a natural philoſopher a view of a quantity of paſte filled with eels, from each of whoſe bodies the light was reflected as when it paſſes through a ſolar microſcope; inſtead of imagining them organic particles, the paſte would appear like a little mountain, he would probably look upon the whole as a monſtrous aſſemblage of ſerpents, and be afraid to come near them. Wherever, therefore, we diſcover beings to appearance endowed with the principle of ſelf-preſervation, or whatever elſe we make the characteriſtic of animals, neither the ſmallneſs of their ſize, nor the impoſſibility of our knowing how they come there, ought to cauſe us doubt of their being really animated.—At the ſame time, it muſt alſo be remembered, that *motion* is not always a characteriſtic of animal life, even though the moving bodies ſhould avoid one another, or any ſeeming obſtacle placed in their way. We know, that inanimate bodies, when electrified, will avoid others endowed with an electricity of the ſame kind, and adhere to thoſe which have the oppoſite one. As we are by no means acquainted with the utmoſt powers of electricity, but on the contrary, from what we do know of it have all the reaſon in the world to conclude that it can produce effects utterly beyond our comprehenſion, it is impoſſible for us to know what ſhare it may have in producing the motions obſerved in vegetable infuſions, or in the ſemen of animals.—We may alſo further obſerve, that though in Mr Ellis's experiment of the boiled potatoe he took it for granted that every ſeed of animal life would be deſtroyed by the boiling water, yet even this cannot be proved; nay, on the contrary, it hath been proved by undeniable experiments, that the human body itſelf hath endured a heat of 240 degrees of Fahrenheit (28 degrees above that of boiling water) without injury. The eggs of theſe animalcula might therefore be ſtrong enough to reſiſt the heat hitherto uſed in Mr Ellis's or any other experiment.

57 Animals ſometimes found living in ſolid bodies.

A conſiderable objection to the exiſtence of animalcules in the ſemen or any other part of animal bodies, muſt ariſe from the total excluſion of air which is found ſo neceſſary to the life of larger animals. Some inſtances, however, have been obſerved of large animals being found in ſuch ſituations as they could not poſſibly have enjoyed the leaſt benefit from the air for a great number of years; and in this ſtate they have not only lived, but lived much longer than they would otherwiſe have done.

In Toulon harbour and the road, are found ſolid hard ſtones, and perfectly entire; containing, in different cells, ſecluded from all communication with the air, ſeveral living ſhell-fiſh, of an exquiſite taſte, called *Dactyli*, i. e. Dates: to come at theſe fiſh, the ſtones are broken with mauls. Alſo, along the coaſt of Ancona, in the Adriatic, are ſtones uſually weighing about 50 pounds, and ſometimes even more; the outſide rugged and eaſily broken, but the inſide ſo hard, as to require a ſtrong arm and an iron maul to break them: within them, and in ſeparate niches, are found ſmall ſhell-fiſh, quite alive, and very palatable, called *Solenes* or *Cappe lunghe*. Theſe facts are atteſted by Gaſſendi, Blondel, Mayol, the learned biſhop of Sulturara, and more particularly by Aldrovandi a phyſician of Bologna. The two latter ſpeak of it as a common fact which they themſelves ſaw.

In the volume for 1719, of the Academy of Sciences at Paris, is the following paſſage:

"In the foot of an elm, of the bigneſs of a pretty corpulent man, three or four feet above the root, and exactly in the centre, has been found a live toad, middle ſized, but lean, and filling up the whole vacant ſpace: no ſooner was a paſſage opened, by ſplitting the wood, than it ſcuttled away very haſtily: a more firm and ſound elm never grew; ſo that the toad cannot be ſuppoſed to have got into it. The egg whence it was formed, muſt, by ſome very ſingular accident, have been

been lodged in the tree at its first growth. There the creature had lived without air, feeding on the substance of the tree, and growing only as the tree grew. This is attested by Mr Hubert, professor of philosophy at Caen."

The volume for the year 1731 has a similar observation, expressed in these words:

"In 1719, we gave an account of a fact, which, though improbable, was well attested; that a toad had been found living and growing in the stem of a middling elm, without any way for the creature to come out or to have got in. M. Seigne, of Nantes, lays before the academy a fact just of the very same nature, except that, instead of an elm, it was an oak, and larger than the elm, which still heightens the wonder. He judges, by the time requisite for the growth of the oak, that the toad must have subsisted in it, without air, or any adventitious aliment, during 80 or 100 years. M. Seigne seems to have known nothing of the fact in 1719."

With the two foregoing may be classed a narrative of Ambrose Paré chief surgeon to Henry III. king of France, who, being a very sensible writer, relates the following fact, of which he was an eye witness:

"Being (says he) at my seat, near the village of Meudon, and over-looking a quarry-man whom I had set to break some very large and hard stones; in the middle of one we found a huge toad, full of life, and without any visible aperture by which it could get there. I began to wonder how it received birth, had grown and lived; but the labourer told me, it was not the first time he had met with a toad, and the like creatures, within huge blocks of stones and no visible opening or fissure."

Observations of living toads, found in very hard and entire stones, occur in several authors, particularly Baptist Fulgosa doge of Genoa, the famous physicians Agricola and Horstius, and lord Verulam: others give very specious accounts of snakes, frogs, crabs, and lobsters, being found alive, inclosed within blocks of marble, rocks, and large stones.

An instance similar to these, of the truth of which we have no reason to doubt, was observed in England in the year 1773, where a large toad was found in the middle of a piece of coal having not the least visible crack or fissure.

58 The subject still obscure.

Upon the whole, therefore, though philosophers are not yet able to discover how these minute creatures are produced; yet, that there really are animals much smaller than what we can discern with our naked eye, seems to be indisputable. The subject, however, is still evidently obscure, and will no doubt require the utmost attention of philosophers, as well as further improvements in the construction of microscopes, fully to investigate it.

Animalcula are said to be the cause of various disorders. The itch, from several experiments, is affirmed to be a disorder arising from the irritations of a species of animalcula found in the pustules of that ailment; whence the communication of it by contact from one to another is easily conceived, as also the reason of the cure being effected by cutaneous applications. On this foundation some have attributed the small-pox and measles, and infectious diseases; others the epilepsy, &c. to animalcules. Langius goes farther, and pretends to reduce all diseases in general to the same principle. A late writer at Paris, who assumed the title of an English physician, has done more. He not only accounts for all diseases, but for the operations of all medicines, from the hypothesis of animalcules. He has peculiar animals for every disease; scorbutic animalcules, podagrical animalcules, variolous animalcules, &c. all at his service. Journ. des Sçav. tom. lxxxii. p. 535, &c.

But as most discoveries in natural philosophy have laid a foundation for the warm imaginations of some men to form visionary theories, to the great prejudice of real knowledge; so those relating to animalcula have been drawn in, however improperly, to support the most whimsical and chimerical systems.

Animalcules Invisible.—Naturalists suppose another species or order of invisible animalcules, *viz.* such as escape the cognizance even of the best microscopes, and give many probable conjectures in relation to them. Reason and analogy give some support to the existence of infinite imperceptible animalcules. The naked eye, say some, takes in from the elephant to the mite; but there commences a new order reserved only for the microscope, which comprehends all these from the mite to those 27 millions of times smaller; and this order cannot be yet said to be exhausted, if the microscope be not arrived at its last perfection. See further on this subject the article Microscope.

ANIMATED, or Animate, in a general sense, denotes something endowed with animal life. It also imports a thing to be impregnated with vermin or animalcules.

Animated Horse-hairs. See *Horse-Hairs.*

ANIMATION signifies the informing an animal body with a soul.—The different hypotheses of physicians and philosophers, concerning the time of animation, have had their influence on the penal laws made against artificial abortions; it having been made capital to procure miscarriage in the one state, while in the other it was only deemed a venial crime. The emperor Charles V. by a constitution published in 1532, put the matter on another footing; instead of the distinction of an animated and unanimated fœtus, he introduced that of vital and non-vital fœtus, as a thing of more obvious and easy decision, and not depending on any system either of creation, traduction, or infusion. Accordingly a fœtus is said, in a legal sense, to be animated, when it is perceived to stir in the womb; which usually happens about the middle of the term of gestation.

ANIME, in heraldry, a term used when the eyes of a rapacious creature are borne of a different tincture from the creature itself.

Anime, a resin exsuding from the trunk of a large American tree, called by Piso *jetaiba*, by the Indians *courbaril*, (a species of Hymenæa). This resin is of a transparent amber colour, a light agreeable smell, and little or no taste. It dissolves entirely, but not very readily, in rectified spirit of wine; the impurities, which are often in large quantity, remaining behind. The Brazilians are said to employ anime in fumigations for pains and aches proceeding from a cold cause: with us, it is rarely, if ever, made use of for any medicinal purposes.

ANIMETTA, among ecclesiastical writers, denotes

notes the cloth wherewith the cup of the eucharist is covered.

ANINGA, in commerce, a root which grows in the Antilles islands, and is pretty much like the China plant. It is used by sugar-bakers for refining the sugar.

ANJOU, a province and duchy of France, bounded on the east by Touraine, on the south by Poictou, on the west by Bretagne, and on the north by Maine. It is 70 miles in length, and in breadth 60. Through this province run five navigable rivers: the Loire, which divides it into two parts; the Vienne, the Toue, the Maienne, and the Sarte.

The air is temperate, and the country agreeably diversified with hills and meadows. There are 33 forests of oak-trees mixed with beech. The country produces white-wine, wheat, barley, rye, oats, pease, beans, flax, hemp, walnuts, and some chesnuts. In Lower Anjou they make cyder. There are fruit-trees of all kinds, and pasture proper for horses. The greatest riches of the province consist in cows, oxen, and sheep. There are several coal and iron mines; and yet there are but two forges in the whole province. There are quarries of marble and of slate; as well as quarries of white stone, proper for building, on the side of the river Loire. Here are also several saltpetre-works and some glass-houses. The remarkable towns, besides Angers the capital, are Saumur, Brisac, Pons de Cea, La Fleche, and Beaufort.

ANIO, (Cicero, Horace, Priscian); ANIEN, (Statius); now *il Teverone:* a river of Italy, which falls into the Tiber, three miles to the north of Rome, not far from Antemnæ. It rises in a mountain near Treba, (Pliny); and, running through the country of the Æquiculi, or Æqui, it afterwards separated the Latins from the Sabines; but nearer its mouth, or confluence, it had the Sabines on each side. It forms three beautiful lakes in its course, (Pliny). In the territories of Tibur it falls from a great height, and there forms a very rapid cataract; hence the epithet *præceps*, and hence the steam caused by its fall, (Horace). *Anienus* is the epithet formed from it, (Virgil, Propertius): *Anienus* is also the god of the river, (Propertius, Statius).

ANISUM, or ANISE. See PIMPINELLA.

ANKER, a liquid measure at Amsterdam. It contains about 32 gallons English measure.

ANKLE, in anatomy, the joint which connects the foot to the leg.—We have an account of the menses being regularly evacuated at an ulcer of the ankle, *Edin. Med. Obs.* vol. iii. art. 29.

ANN, or ANNAT, in Scots law, is half a year's stipend, which the law gives to the executors of Ministers of the church of Scotland, over and above what was due to the minister himself, for his incumbency.

ANNA, one of the three principalities into which Arabia deserta is divided.

ANNA, one of the chief cities of the above principality, and formerly a famed mart-town, is situated in Lat. 33. 57. and E. Long. 42. 10. on the river Euphrates, in a fruitful and pleasant soil. It has two streets, which are divided by the river. That on the Mesopotamia side is about two miles long, but thinly peopled, and by none but tradesmen; that on the opposite side is about six miles in length, and it is there that the principal inhabitants of the city dwell. Every house has some ground belonging to it; and these grounds are loaded with noble fruit-trees, as lemons, oranges, citrons, quinces, figs, dates, pomegranates, olives, all very large and in great plenty. Some of the flat grounds are sown with corn and other grain, which yields likewise a considerable crop. This city is the common rendezvous of all the robbers that infest the country, and from which they disperse themselves into all parts of the Desart. Here they meet to consult; here they hold their grand council, and deliberate where to rob next with success. It is with great difficulty that the Turkish aga, and the janissaries, who are kept here, can levy the tribute imposed by the Turks on all the commodities carried through this city, which is one of the great thorough-fares for the passing of the caravans that go to and from Aleppo, Tripoli, Damascus, Bagdad, and some other parts of the Turkish empire.

ANNA Comnena. See COMNENA.

ANNABON. See ANNOBON.

ANNALE, in the Church of Rome, a term applied to the masses celebrated for the dead during a whole year.

ANNALIS CLAVUS, the nail which the Prætor, Consul, or Dictator, drove into the wall of Jupiter's temple annually upon the Ides of September, to show the number of years. But this custom was superseded by reckoning years by consulships. The ceremony was sometimes performed to avert the plague, &c.

ANNALS, in matters of literature, a species of history, which relates events in the chronological order wherein they happened. They differ from perfect history in this, that annals are but a bare relation of what passes every year, as a journal is of what passes every day; whereas history relates not only the transactions themselves, but also the causes, motives, and springs of actions. Annals require nothing but brevity; history demands ornament.—Cicero informs us of the origin of annals. To preserve the memory of events, the *Pontifex Maximus*, says he, wrote what passed each year, and exposed it on tables in his own house, where every one was at liberty to read; this they called *annales maximi*; and hence the writers who imitated this simple method of narrating facts were called *annalists*.

ANNAN, the capital of Annandale, a division of Dumfriesshire in Scotland; a small town, containing 500 or 600 inhabitants, and situated on a river of the same name, in W. Long. 3°. N. Lat. 54. 40. This place, which is a royal borough, has some trade in wine, and exports annually between 20 and 30,000 Winchester bushels (10 and 15,000 bolls) of corn. Vessels of about 250 tons can come within half a mile of the town; and of 60, as high as the bridge; which consists of five arches, defended by a gateway. A fabric for carding and spinning of cotton has lately been erected, and the town begins to increase. Here was formerly a castle; which was built by the Bruces after they became lords of Annandale. Upon the death of David II. the son of King Robert, in 1371, this castle (Lochmaben), and the lordship of Annandale, came to Thomas Randolf Earls of Murray, and went with his sister Agnes to the Dunbars, Earls of March: after their forfeiture it went to the Douglasses, who also, lost it by the same fate; and then having come to Alex-

Annan. Annand.

Alexander Duke of Albany, he, for rebelling against his brother King James III. and plundering the fair of Lochmaben in 1484, was also forfeit. Since which time it continued in the hands of the King, and became the great key of the west border.

The stewarty or district of Annandale, of which Lochmaben castle was the chief fortalice, is a fertile vale, 24 miles long and about 14 miles broad: from its vicinity to England, and the continual incursions and predatory wars of the borderers, the greatest part of it was uncultivated and common: but since the beginning of the present century, or rather within the last thirty years, all these wastes and commons have been divided and brought into culture, and the country has assumed a new appearance; which may be ascribed not only to the division of the commons, but likewise to the improvement made in the roads, and particularly in the great western road from Edinburgh to London by Moffat, Gratney, and Carlysle, running through this vale, and carried on by some gentlemen of the country, after they had obtained an act of parliament for levying a toll to defray the expence of making and keeping it in repair.

Annandale formed a part of the Roman province of Valentia; and Severus's wall ending here, it abounds with Roman stations and antiquities. The camps at Birrens in Middlebie, and on the hill of Burnswork, are still entire, and their form is preserved; and the traces and remains of a military road are now visible in different parts of the country. The ruins of the house or castle of Auchincass, in the neighbourhood of Moffat, once the seat of that potent baron, Thomas Randolph, Earl of Murray, Lord of Annandale, and Regent of Scotland, in the minority of David II. covers above an acre of ground, and even now conveys an idea of the plan and strength of the building. The ancient castle of Comlongan formerly belonging to the Murrays, Earls of Annandale, and now to Lord Stormont, is still in a tolerable state of preservation; but except this castle and that of Hoddom, most of the other old fortalices and towers are now taken down, or in ruins.

Annandale is a marquisate belonging to the Johnstons, and the chief of the name.

ANNAND (William), dean of Edinburgh, in Scotland, the son of William Annand minister of Air, was born at Air in 1633. Five years after, his father was obliged to quit Scotland with his family, on account of their loyalty to the king, and adherence to the episcopal government established by law in that country. In 1651, young Annand was admitted a scholar in University college in Oxford; and though he was put under the care of a presbyterian tutor, yet he took all occasions to be present at the sermons preached by the loyal divines in and near Oxford. In 1656, being then bachelor of arts, he received holy orders from the hands of Dr Thomas Fulwar, bishop of Ardfert or Kerry in Ireland, and was appointed preacher at Weston on the green near Bicester in Oxfordshire, where he met with great encouragement from Sir Francis Norris lord of that manor. After he had taken his degree of master of arts, he was presented to the vicarage of Leighton-Buzzard in Bedfordshire; where he distinguished himself by his edifying manner of preaching, till 1662, when he went into Scotland, in quality of chaplain to John Earl of Middleton the king's high-commissioner to the church of that kingdom. In the latter end of the year 1663, he was instituted to the tolbooth church at Edinburgh, and from thence was removed some years after to the trone church of that city, which is likewise a prebend. In April 1676, he was nominated by the king to the deanery of Edinburgh; and in 1685, he commenced Doctor of Divinity in the university of St Andrew's. He wrote, 1. *Fides Catholica*, or The Doctrine of the Catholic Church in eighteen grand Ordinances, referring to the word, sacraments, and prayer, in purity, number, and nature, catholically maintained, and publicly taught against heritics of all sorts. Lond. 1661-2, 4to. 2. Solutions of many proper and profitable questions, suitable to the nature of each Ordinance, &c. printed with the Fides Catholica. 3. *Panem Quotidianem*; or A short Discourse tending to prove the legality, decency, and expediency, of set forms of prayers in the Churches of Christ, with a particular Defence of the Book of Common Prayer of the Church of England. Lond. 1661, 4to. 4. *Pater Noster*, Our Father; or The Lord's Prayer explained, the sense thereof, and duties therein, from Scripture, History, and the Fathers, methodically cleared, and succinctly opened. Lond. 1670, 8vo. 5. *Mysterium Pietatis*, or The Mystery of Godliness, &c. Lond. 1672, 8vo. 6. *Doxologia*, or Glory to the Father, the Church's Hymn, reduced to glorifying the Trinity. Lond. 1672, 8vo. 7. *Dualitas*, or A twofold subject displayed and opened, conduceable to godliness and peace in order: first *Lex loquens*, the honour and dignity of magistracy, with the duties thereupon, &c. Secondly, *Duorum Unitas*, or The agreement of magistracy and ministry at the election of the honourable magistrates at Edinburgh, and opening of the Diocesan Synod of the Reverend Clergy there. Edin. 1674, 4to. Dr Annand died the 13th of June 1689, and was honourably interred in the Grey-Friars church in Edinburgh.

Annand Annapolis.

ANNANO, a strong fort of Italy, in the duchy of Milan. It has been twice taken by the French; but was restored to the duke of Savoy in 1706. It is seated on the river Tanaro, in E. Long. 8. 30. N. Lat. 44. 40.

ANNAPOLIS, the capital of Maryland, in North America; said to be the wealthiest town of its size in America. Situated at the mouth of the river Severn, about 30 miles south of Baltimore. It was formerly known by the name of Severn, and received its present name in 1694, when it was made a port town, and the residence of a collector and naval officer. The houses are generally large and elegant. The streets generally diverge from the state house like the radii of a circle, the state house is the noblest building of the kind in America. W. Long. 78. 10. N. Lat. 39. 25.

ANNAPOLIS ROYAL, a town of Nova Scotia, is seated in the bay of Fundy; and, though a mean place, was formerly the capital of the province. It has one of the finest harbours in America, capable of containing 1000 vessels at anchor in the utmost security. The place is also protected by a fort and garrison. At the bottom of the harbour is a point of land, which divides two rivers; and on each side there are pleasant meadows, which in spring and autumn are covered with all sorts of fresh-water fowl. There is a trade carried on by the Indians with furs, which they exchange for European goods. W. Long. 64. 5. N. Lat. 45. 10.

ANNATES,

Annates. Annealing.

ANNATES, among ecclesiastical writers, a year's income of a spiritual living.

These were, in ancient times, given to the Pope through all Christendom, upon the decease of any bishop, abbot, or parish-clerk, and were paid by his successor. At the Reformation they were taken from the Pope, and vested in the king; and, finally, Queen Anne restored them to the church, by appropriating them to the augmentation of poor livings.

ANNEALING, by the workmen called *nealing*, is particularly used in making glass: it consists in placing the bottles, &c. whilst hot, in a kind of oven, or furnace, where they are suffered to cool gradually; they would otherwise be too brittle for use.—Metals are rendered hard and brittle by hammering: they are therefore made red hot, in order to recover their malleability; and this is called *nealing*.

The difference between unannealed and annealed glass, with respect to brittleness, is very remarkable. When an unannealed glass-vessel is broken, it often flies into a small powder, with a violence seemingly very unproportioned to the stroke it has received. In general, it is in greater danger of breaking from a very slight stroke than from one of some considerable force. One of those vessels will often resist the effects of a pistol-bullet dropt into it from the height of two or three feet; yet a grain of sand falling into it, will make it burst into small fragments. This takes place sometimes immediately on dropping the sand into it: but often the vessel will stand for several minutes after, seemingly secure; and then, without any new injury, it will fly to pieces. If the vessel be very thin, it does not break in this manner, but seems to possess all the properties of annealed glass.

The same phenomena are still more strikingly seen in glass drops or tears. They are globular at one end, and taper to a small tail at the other. They are the drops which fall from the melted mass of glass on the rods on which the bottles are made. They drop into the tubs of water which are used in the work; the greater part of them burst immediately in the water. When those that remain entire are examined, they discover all the properties of unannealed glass in the highest degree. They will bear a smart stroke on the thick end without breaking; but if the small tail be broken, they burst into small powder with a loud explosion. They appear to burst with more violence, and the powder is smaller in an exhausted receiver than in the open air. When they are annealed, they lose those properties.

Glass is one of those bodies which increase in bulk when passing from a fluid to a solid state. When it is allowed to crystallize regularly, the particles are so arranged, that it has a fibrous texture: it is elastic, and susceptible of long continued vibrations; but when a mass of melted glass is suddenly exposed to the cold, the surface crystallizes, and forms a solid shell round the interior fluid parts: this prevents them from expanding when they become solid. They, therefore, have not the opportunity of a regular crystallization; but are compressed together with little mutual cohesion: On the contrary, they press outward to occupy more space, but are prevented by the external crust. In consequence of the effort of expansion in the internal parts, the greater number of glass drops burst in cooling; and those which remain entire are not regularly crystallized. A smart stroke upon them communicates a vibration to the whole mass, which is nearly synchronous in every part; and therefore the effort of expansion has little more effect than if the body were at rest; but the small tail and the surface only are regularly crystallized. If the tail be broken, this communicates a vibration along the crystallized surface, without reaching the internal parts. By this they are allowed some expansion; and overcoming the cohesion of the thin outer shell, they burst it and are dispersed in powder.

Annealing.

In an unannealed glass-vessel the same thing takes place. Sometimes the vibration may continue for a considerable time before the internal parts overcome the resistance. If the vessel be very thin, the regular crystallization extends through the whole thickness; or at least the quantity of compressed matter in the middle is so inconsiderable, as to be incapable of bursting the external plate.

By the process of annealing, the glass is kept for some time in a state approaching to fluidity; the heat increases the bulk of the crystallized part, and renders it so soft, that the internal parts have the opportunity of expanding and forming a regular crystallization.

A similar process is now used for rendering kettles and other vessels of cast-iron less brittle: of it the same explanation may be given. The greater number of metals diminish in bulk when they pass from a fluid to a solid state; iron, on the contrary, expands.

When cast-iron is broken, it has the appearance of being composed of grains: forged or bar iron appears to consist of plates. Forged iron has long been procured, by placing a mass of cast-iron under large hammers, and make it undergo violent and repeated compression. A process is now used for converting cast-iron into forged, by heat alone. The cast-iron is placed in an air-furnace, and kept for several hours in a degree of heat, by which it is brought near to a fluid state. It is then allowed to cool gradually, and is found to be converted into forged-iron. This process is conducted under a patent; although, if Reaumur's experiments upon cast-iron be consulted, it will appear not to be a new discovery.

By these experiments it is ascertained, that if cast-iron be exposed for any length of time to a heat considerably below its melting point, the texture and properties are not changed: but if it be kept in a heat near the melting point, the surface soon becomes lamellated like forged-iron; and the lamellated structure extends farther into the mass in proportion to the length of time in which it is exposed to that degree of heat. When it is continued for a sufficient time, and then allowed to cool gradually, it is found to possess the lamellated structure throughout.

Cast-iron, then, is brittle, because it has not had the opportunity of crystallizing regularly. When it is exposed to cold while fluid, the surface becoming solid, prevents the inner parts from expanding and arranging themselves into regular crystals. When cast-iron is brought near to the melting-point, and continued for a sufficient length of time in that degree of heat, the particles have the opportunity of arranging themselves into that form of crystals by which forged-iron is distinguished, and by which it possesses cohesion and all its properties.

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There appears, therefore, to be no other essential difference between forged and cast iron, except what arises from the crystallization. Cast-iron is indeed often not sufficiently purified from other substances which are mixed with the calx. It appears also to contain a considerable quantity of calx unreduced; for during the process for converting it into forged-iron by heat alone, a pale flame rises from the metal till near the end of the process. This is owing to fixed air which the heat forces off from the calx. The expulsion of this air reduces the calx, and thereby frees the metal from that injurious mixture.

That this explanation of the annealing of iron is probable, appears also from the well-known fact of forged-iron being incomparably more difficult of fusion than cast-iron. A piece of forged iron requires a very violent heat to melt it; but when it is reduced to a small powder, it melts in a much lower degree of heat. Iron diminishes in bulk when it passes into a fluid state, while most other metals increase in volume. The expansion which heat occasions in bringing them to their melting point, will be favourable to their fluidity, by gradually bringing the particles to the same state of separation in which they are when the mass is fluid; but the expansion of iron by heat removes it farther from that state, and keeps it in the state which is favourable to the continuance of it in a crystallized form. It will not melt till the heat expand it so much that the cohesion of crystallization be overcome. When it is reduced to a minute powder before it be exposed to the heat, it melts sooner. The crystals having been destroyed, that cohesion has no effect in preventing it from passing into a state of fluidity.

Upon the same principles may be explained the almost peculiar property of welding possessed by iron, and and the conversion of forged iron into steel.

But perhaps they may also be applied to platina, a metal which has lately gained much attention. It possesses some of the properties of iron. It is still more difficult of fusion than that metal. It is susceptible of being welded. The natural grains of it can scarcely be melted in the focus of the most powerful burning glass; but when it is dissolved in aqua regia, and precipitated by the vegetable alkali, it has been melted in small globules by the blow-pipe. When precipitated by sal ammoniac, it has been melted in a considerable mass in the heat of a furnace; but it is said to be hard and brittle.

Many attempts have been made to procure a mass of it in a malleable state, but without success. It is said that the process is now discovered by a chemist in Spain. The treatment of the metal is probably very simple. Perhaps it only consists in precipitating it in a minute powder from aqua regia, exposing it to strong heat which melts it, and keeping it for some time in a state nearly fluid, that it may, like iron, crystallize regularly: by this it will possess all its metallic properties.

ANNE, Queen of Great-Britain, daughter of James II. when Duke of York, was born in 1664, and married to Prince George of Denmark in 1683, by whom she had several children, but survived them all. Upon the death of William III. March 8, 1702, she succeeded to the throne, and to a war with France, which was prosecuted under her reign by the great Duke of Marlborough, with more glory than profit to the nation. She effected the long wished-for union between England and Scotland, which took place May 1st, 1707; and dying August 1st, 1714, was succeeded by George Lewis Augustus Elector of Hanover, as the direct descendant from James I. by his daughter Elizabeth queen of Bohemia.

Annecy. Annesley.

St Ann's Day, a festival of the Christian church, celebrated by the Latins on the 26th of July, but by the Greeks on the 9th of December. It is kept in honour of Anne, or Anna, mother of the Virgin Mary.

ANNECY, a city of Savoy, seated between Chamberry and Geneva, on the banks of a lake of the same name, from whence run several brooks, which flow through the town, and uniting at length form a river. There are piazzas in most of the streets of the town, which serve to shelter the inhabitants from rain. It has several collegiate and parish churches, as well as convents for men and women. The lake is about nine miles long and four broad. E. Long. 6. 12. N. Lat. 45. 53.

ANNESLEY (Arthur), Earl of Anglesey, and lord privy seal in the reign of King Charles II. was the son of Sir Francis Annesley, Bart. Lord Mount Morris, and Viscount Valentia, in Ireland; and was born at Dublin on the 10th of July 1614. He was for some time at the university of Oxford, and afterwards studied the law at Lincoln's-Inn. He had a considerable share in the public transactions of the last century: for in the beginning of the civil war he sat in the parliament held at Oxford; but afterwards became reconciled to the opposite party, and was sent commissioner to Ulster, to oppose the designs of the rebel Owen Roe Oneal. He engaged in several other affairs with great success. He was president of the council of state after the death of Oliver, and was principally concerned in bringing about the Restoration: soon after which King Charles II. raised him to the dignity of a Baron, by the title of Lord Annesley, of Newport Pagnel, Bucks; and a short time after, he was made Earl of Anglesey. During that reign he was employed in some very important affairs, was made treasurer of the navy, and afterwards lord privy-seal. In October 1680, his lordship was charged by one Dangerfield, in an information delivered upon oath, at the bar of the house of commons, with endeavouring to stifle evidence in relation to the Popish plot, and to promote the belief of a Presbyterian one. The uneasiness he received from this attack did not prevent his speaking his opinion freely of those matters in the house of lords, particularly in regard to the Popish plot. About the same time he answered the Lord Castlehaven's Memoirs, in which that nobleman endeavoured to paint the Irish rebellion in the lightest colours; and a sharp dispute was raised, which ended in the seals being taken from him. He was a person of great abilities, had uncommon learning, and was well acquainted with the constitution and laws of England. He wrote, besides his Animadversions on Castlehaven's Memoirs, 1. The Privileges of the House of Lords and Commons stated. 2. A Discourse on the House of Lords. 3. Memoirs. 4. The History of the Troubles in Ireland, from the rebellion in 1641 till the restoration. 5. Truth Unveiled, in behalf of the Church of England;—and some other works. He died in April 1686, in the 73d year of his age; and was succeeded by his son James.

Annexation, Annihilation.

ANNEXATION, in law, a term used to imply the uniting of lands or rents to the crown.

ANNIHILATION, the act of reducing any created being into nothing.

Christians, Heathens, Jews, Siamese, Persians, divines, philosophers, &c. have their peculiar systems, sentiments, conjectures, not to say dreams, concerning annihilation; and we find great disputes among them about the reality, the possibility, the means, measures, prevention, ends, &c. of annihilation.

The first notions of the production of a thing from, or reduction of it to, nothing, Dr Burnet shows, arose from the Christian theology; the words *creation* and *annihilation*, in the sense now given to them, having been equally unknown to the Hebrews, the Greeks, and the Latins.

The ancient philosophers in effect denied all annihilation as well as creation, resolving all the changes in the world into new modifications, without supposing the production of any thing new, or destruction of the old. By daily experience, they saw compounds dissolved; and that in their dissolution nothing perished but their union or connection of parts: when in death the body and soul were separated, the man they held was gone, but that the spirit remained in its original the great soul of the world, and the body in its earth from whence it came; these were again wrought by nature into new compositions, and entered new states of being which had no relation to the former.

The Persian bramins hold, that after a certain period of time, consisting of 71 joogs, God not only annihilates the whole universe, but every thing else, angels, souls, spirits, and all, by which he returns to the same state he was in before the creation; but that, having breathed a while, he goes to work again, and a new creation arises, to subsist 71 joogs more, and then to be annihilated in its turn. Thus they hold there have been almost an infinite number of worlds: but how many joogs are elapsed since the last creation, they cannot certainly tell; only in an almanac written in the Shanscrit language in 1670, the world is said to be then 3,892,771 years old from the last creation.

The Siamese heaven is exactly the hell of some Socinians and other Christian writers; who, shocked with the horrible prospect of eternal torments, have taken refuge in the system of annihilation. This system seems countenanced by Scripture; for that the words *death*, *destruction*, and *perishing*, whereby the punishment of the wicked is most frequently expressed in Scripture, do most properly import annihilation and an utter end of being. To this Tillotson answers, that these words, as well as those corresponding to them in other languages, are often used, both in Scripture and other writings, to signify a state of great misery and suffering, without the utter extinction of the miserable. Thus God is often said in Scripture to bring destruction on a nation, when he sends judgments upon them, but without exterminating or making an end of them. So, in other languages, it is frequent, by *perishing*, to express a person's being made miserable; as in that known passage in Tiberius's letter to the Roman senate: *Ita me dii, deæque omnes, pejus perdant, quam hodie perire me sentio.* As to the word *death*, a state of misery which is as bad or worse than death may properly enough be called by that name; and thus the punishment of wicked men after the day of judgment is in the book of Revelations frequently called the *second death*.

Annihilation.

Some Christian writers allow a long time of the most terrible torments of sinners; and after that suppose that there shall be an utter end of their being. Of this opinion Irenæus appears to have been; who, according to M. du Pin, taught that the souls, at least of the wicked, would not subsist eternally; but that, after having undergone their torments for a certain period, they would at last cease to be at all. But Tillemont, Petit, Didier, and others, endeavour to defend Irenæus from this imputation, as being too favourable to the wicked.

It has been much disputed among divines, whether, at the consummation of all things, this earth is to be annihilated, or only purified, and fitted for the habitation of some new order of beings. Gerard in his Common Places, and Hakewil in his Apology, contend earnestly for a total abolition or annihilation. Ray, Calmet, and others, think the system of renovation or restitution more probable, and more consonant to Scripture, reason, and antiquity. The fathers who have treated on the question are divided; some holding that the universe shall not be annihilated, but only its external face changed; others asserting, that the substance of it shall be destroyed.

How widely have the sentiments of mankind differed as to the possibility and impossibility of annihilation! According to some, nothing so difficult; it requires the infinite power of the Creator to effect it: some go further, and seem to put it out of the power of God himself. According to others, nothing so easy: Existence is a state of violence; all things are continually endeavouring to return to their primitive nothing; it requires no power at all; it will do itself; nay, what is more, it requires an infinite power to prevent it.

Many authors consider preservation as a continual reproduction of a thing, which, subsisting no longer of itself, would every moment return into nothing. Gassendi on the contrary asserts, that the world may indeed be annihilated by the same power which first created it, but that to continue it there is no occasion for any power of preservation.

Some divines, of which number the learned Bishop King seems to be, hold annihilation for the greatest of all evils, worse than even the utmost torments of hell-flames; while others, with some of the eastern philosophers, acknowledge annihilation for the ultimate pitch of happiness human nature is capable of; that sovereign good, that absolute beatitude, so long vainly sought for by the philosophers, is found here. No wonder it had been so long concealed; for who would have thought of looking for the *summum bonum*, where others have placed the sum of misery?

The said prelate proposes it as a question, Whether suffering eternal torments be a greater evil than not existing? He thinks it highly probable, that the damned will be such fools, that, feeling their own misery in the most exquisite degree, they will rather applaud their own conduct, and choose to be, and to be what they are, rather than not to be at all; fond of their condition, however wretched, like people enraged, they will persist in their former sentiments without opening their eyes to their folly, and persevere by way of indignation and revenge. Mr Bayle refutes him on this head; but might, one would think, have saved himself the trouble.

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The Talapoins hold it the supreme degree of happiness to have the soul totally annihilated, and freed from the burden and slavery of transmigrations. They speak of three Talapoins, who, after a great number of transmigrations, became gods; and when arrived at this state, procured this further reward of their merit to be annihilated. The ultimate reward of the highest perfection man can arrive at is *nieurepan*, or annihilation; which at length is granted to those who are perfectly pure and good, after their souls have wandered many thousand years through various bodies.

ANNI NUBILES, in law denotes the marriageable age of a woman, viz. after she has arrived at twelve.

ANNIVERSARY, the annual return of any remarkable day. Anniversary days, in old times, more particularly denoted those days in which an office was yearly performed for the souls of the deceased, or the martyrdom of the saints was yearly celebrated in the church.

ANNOBON, a small island of Africa, on the coast of Loango, belonging to the Portuguese. It lies in E. Long. 5. 10. S. Lat. 1. 50. and receives its name from being discovered on New-year's day. According to Pyrard, it is about five or six French leagues in compass; but Bandrand says, it is ten leagues round. Here are two high mountains, the tops of which being continually covered with clouds, occasion frequent rains. On the south-east of the island are two rocks; one of which is low, and upon a level with the surface of the sea; the other higher and larger, but both dangerous in the night to shipping; but between them the channel is deep and clear. These rocks are inhabited by vast numbers of birds, so tame, that the sailors frequently catch them with their hands. On the same side of the island is a convenient watering-place at the foot of a rivulet, which tumbles from the mountains down to a valley covered with orange and citron trees, &c. and affording a pleasant and refreshing shade; but the road on the north-west side is difficult and dangerous, though most frequented by ships who have no intention of touching upon the continent. In either place it is difficult to take in a sufficient quantity of water, on account of the violent breakings of the sea, and a stone intrenchment erected by the negroes, from which they annoy all strangers that attempt to land. The true road for shipping lies on the north-east side, where they may anchor in seven, ten, thirteen, or sixteen fathoms, on a fine sand close to the land, opposite to the village where the negroes have thrown up their intrenchments.

The climate is wholesome, and the air clear and serene for the greatest part of the year. Every part of the island is watered by pleasant brooks, and fresh-water springs, which, however, at the new and full moons, or in all high tides acquire a brackishness. The banks of every rivulet are covered with palms, whence the inhabitants extract their wine by incision. Here a number of fertile valleys, which produce Turkey corn, rice, millet, yams, potatoes, &c. and afford pasture for abundance of oxen, sheep, goats, &c. Poultry and fish also abound here; but the only mercantile production is cotton, which is esteemed equal in quality to any produced in India, though the quantity is small.

In the year 1605, the Dutch admiral Matelief found 200 negroes, and two Portuguese, on Annobon, most of them able to bear arms, expert in the use of them, and trained up in military discipline. La Croix says, it has a town opposite to the road that contains above 100 houses, the whole surrounded by a parapet. Most of their dwellings are cane-huts. In the whole island there is not a single house built of stone, and only two of wood, which belong to the Portuguese. All the inhabitants are meanly clothed; the women go bare-headed, and have also the upper part of the body naked, modesty being defended by a piece of linen wrapt under their stomach, and falling down in the form of a petticoat, or wide apron to the knees. As to the men, they wear only a linen girdle round the loins, with a small flap before. The women carry their children on their backs, and suckle them over the shoulder. All the inhabitants are subject to the Portuguese governor, who is the chief person in the island; at the same time that the negroes have their own chief, subordinate to him. They are all rigid catholics, having been either compelled or persuaded by the arguments of the Portuguese to embrace, and, like all other converts, they are bigotted in proportion to the novelty of their belief, and their ignorance of the true tenets.

ANNO DOMINI, i. e. the year of our Lord; the computation of time from our Saviour's incarnation.

ANNOMINATION, in rhetoric, the same with what is otherwise called *paronomasia*. See PARONOMASIA.

ANNONA, in Roman antiquity, denotes provision for a year, of all sorts, as of flesh, wine, &c. but especially of corn. Annona is likewise the allowance of oil, salt, bread, flesh, corn, wine, hay, and straw, which was annually provided by the contractors for the maintenance of an army.

ANNONA, the *Custard Apple*: A genus of the polygynia order, belonging to the polyandria class of plants; and in the natural method ranking under the 52d order, *Coadunatæ*. The characters are: The *calyx* is a triphyllous perianthium: The *corolla* consists of six heart-shaped petals: The *stamina* have scarcely any filaments; the antheræ are numerous, sitting on the receptaculum: The *pistillum* has a roundish germen; no styli; the stigmata obtuse and numerous: The *pericarpium* is a large roundish, unilocular berry covered with a scaly bark: The *seeds* are numerous.

Species. 1. The reticulata, or custard-apple, is a native of the West-Indies, where it grows to the height of 25 feet, and is well furnished with branches on every side: the bark is smooth, and of an ash colour; the leaves are of a light green, oblong, and have several deep transverse ribs or veins, ending in acute points; the fruit is of a conical form, as large as a tennis-ball, of an orange colour when ripe, having a soft, sweet, yellowish pulp, of the consistence of a custard, from whence it has its name. 2. The muricata, or sour-sop, rarely rises above 20 feet high, and is not so well furnished with branches as the other; the leaves are broader, have a smooth surface without any furrows, and are of a shining green colour: the fruit is large, of an oval shape, irregular, and pointed at the top, of a greenish yellow colour, and full of small knobs on the outside: the pulp is soft, white, and of a sour and sweet taste, intermixed, having many oblong, dark-

 coloured

coloured feeds. 3. The fquamofa, or fweet fop, feldom rifes higher than 15 feet, and well furnifhed with branches on every fide. The leaves have an agreeable fcent when rubbed; the fruit is roundifh and fcaly, and when ripe turns of a purple colour, and hath a fweet pulp. 4. The paluftris, or water-apple, grows to the height of 30 or 40 feet. The leaves are oblong, pointed, with fome flender furrows, and have a ftrong fcent when rubbed; the fruit is feldom eaten but by negroes. The tree grows in moift places in all the Weft-India iflands. 5. The Cherimola, with oblong fcaly fruit, is a native of Peru, where it is much cultivated for the fruit, and grows to be a very large tree well furnifhed with branches. The leaves are of a bright green colour, and much larger than thofe of any of the other forts. The fruit is oblong, and fcaly on the out fide, of a dark purple colour when ripe, and the flefh is foft and fweet, intermixed with many brown feeds which are fmooth and fhining. 6. The Africana, with fmooth bluifh fruit. 7. The Afiatica, or purple apple. This grows in fome of the French iflands, as alfo in Cuba, in great plenty. The trees rife to the height of 30 feet or more. The fruit is efteemed by the inhabitants of thofe iflands, who frequently give them to fick perfons. 8. The triloba, or North-American annona, called by the inhabitants *papaw*, is a native of the Bahama iflands, and likewife of Virginia and Carolina. The trunks of the trees are feldom bigger than the fmall of a man's leg, and are about 10 or 12 feet high, having a fmooth greenifh-brown bark. In March, when the leaves begin to fprout, the bloffoms appear, confifting of fix greenifh white petals. The fruit grows in clufters of three, and fometimes of four together: when ripe, they are yellow, covered with a thin fmooth fkin, which contains a yellow pulp of a fweet lufcious tafte. In the middle of this pulp, lie in two rows twelve feeds, divided by as many thin membranes. All parts of the tree have a rank, if not a fetid fmell, nor is the fruit relifhed by many except negroes. Thefe trees grow in low fhady fwamps, and in a very fat foil.

Culture. The laft fort will thrive in the open air in Britain, if it is placed in a warm and fheltered fituation; but the plants fhould be trained up in pots, and fheltered in winter for two or three years till they have acquired ftrength. The feeds frequently remain a whole year in the ground; and therefore the earth in the pots ought not to be difturbed, though the plants do not come up the firft year. If the pots where thofe plants are fown are plunged into a new hot-bed, they will come up much fooner than thofe that are expofed to the open air. All the other forts require to be kept in a warm ftove, or they will not live in Britain.

ANNONÆ PREFECTUS, in antiquity, an extraordinary magiftrate, whofe bufinefs it was to prevent a fcarcity of provifion, and to regulate the weight and finenefs of bread.

ANNONAY, a fmall town of France, in the Upper Vivarais, feated on the river Deunre. E. Long. 4. 52. N. Lat. 45. 15.

ANNOT, a fmall city in the mountains of Provence in France. E. Long. 7. 0. N. Lat. 44. 4.

ANNOTATION, in matters of literature, a brief commentary or remark, upon a book or writing, in order to clear up fome paffage, or draw fome conclufion from it.

ANNOTTA. See ANOTTA.

ANNUAL, in a general fenfe, an appellation given to whatever returns every year, or is always performed within that fpace of time.

ANNUAL Motion of the Earth. See ASTRONOMY.

ANNUAL Leaves, are fuch leaves as come up afrefh in the fpring, and perifh in winter. Thefe ftand oppofed to *Ever-greens*.

ANNUAL Plants, called alfo fimply *annuals*, are fuch as only live their year, *i. e.* come up in the fpring and die again in the autumn; and accordingly are to be recruited every year.

ANNUALRENT is ufed, in Scots law, to denote an yearly profit due by a debtor in a fum of money to a creditor for the ufe of it.

Right of ANNUALRENT, in Scots law, the original method of burdening lands with an yearly payment for the loan of money, before the taking of intereft for money was allowed by ftatute.

ANNUEL OF NORWAY, of which mention is made in the acts of parliament of king James III. was an annual payment of an hundred marks Sterling, which the kings of Scotland were obliged to pay to the kings of Norway, in fatisfaction for fome pretenfions which the latter had to the Scottifh kingdom, by virtue of a conveyance made thereof by Malcom Kenmore, who ufurped the crown after his brother's deceafe. This annuel was firft eftablifhed in 1266; in confideration whereof the Norwegians renounced all title to the fucceffion of the ifles of Scotland. It was paid till the year 1461, when the annuel, with all its arrears, was renounced in the contract of marriage between king James III. and Margaret daughter of Chriftian I. king of Norway, Denmark, and Sweden.

ANNUITY, a fum of money, payable yearly, half yearly, or quarterly, to continue a certain number of years, for ever, or for life.

An annuity is faid to be an arrear, when it continues unpaid after it falls due. And an annuity is faid to be in reverfion, when the purchafer, upon paying the price, does not immediately enter upon poffeffion; the annuity not commencing till fome time after.

Intereft on annuities may be computed either in the way of fimple or compound intereft. But compound intereft being found moft equitable, both for buyer and feller, the computation by fimple intereft is univerfally difufed.

I. *Annuities for a certain time*.

PROBLEM I. Annuity, rate, and time, given, to find the amount, or fum of yearly payments, and intereft.

RULE. Make 1 the firft term of a geometrical feries, and the amount of 1 l. for a year the common ratio; continue this feries to as many terms as there are years in the queftion; and the fum of this feries is the amount of 1l. annuity for the given years; which multiplied by the given annuity, will produce the amount fought.

EXAMPLE. An annuity of 40l. payable yearly, is forborn and unpaid till the end of 5 years; What will then be due, reckoning compound intereft at five *per cent*. on all the payments then in arrear?

1 : 1.05

Annuity.

1 5 5 4 5
1 : 1.05 : 1.1025 : 1.157625 : 1. 21550625 ? whose ſum is 5.525631251. ; and 5.25563125 × 40 = 221.02525 = 221 l. 0s. 6d. the amount ſought.

The amount may alſo be found thus : Multiply the given annuity by the amount of 1 l. for a year ; to the product add the given annuity, and the ſum is the amount in 2 years ; which multiply by the amount of 1 l. for a year ; to the product add the given annuity, and the ſum is the amount in 3 years, &c. The former queſtion wrought in this manner follows.

40 am. in 1 year.	126.1 am. in 3 years
1.05	1.05
42.00	132.405
40	40
82 am. in 2 years,	172.405 am. in 4 years.
1.05	1.05
86.10	181.02525
40	40
126.1 am. in 3 years.	221.02525 am. in 5 years.

If the given time be years and quarters, find the amount for the whole years, as above ; then find the amount of 1 l. for the given quarters ; by which multiply the amount for the whole years ; and to the product add ſuch a part of the annuity as the given quarters are of a year.

If the given annuity be payable half yearly, or quarterly, find the amount of 1 l. for half a year or a quarter ; by which find the amount for the ſeveral half-years or quarters, in the ſame manner as the amount for the ſeveral years is found above.

Prob. 2. Annuity, rate, and time given, to find the preſent worth, or ſum of money that will purchaſe the annuity.

Rule. Find the amount of the given annuity by the former problem ; and then, by compound intereſt, find the preſent worth of this amount, as a ſum due at the end of the given time.

Examp. What is the preſent worth of an annuity of 40l. to continue 5 years, diſcounting at 5 *per cent.* compound intereſt ?

By the former problem, the amount of the given annuity for 5 years, at 5 *per cent.* is 221.02525 ; and by compound intereſt, the amount of 1 l. for 5 years, at 5 *per cent.* is 1.2762815625.

And, 1.2762815625) 221.02525000(173.179 = 173l. 3s. 7d. the preſent worth ſought.

The preſent worth may be alſo found thus : By compound intereſt, find the preſent worth of each year by itſelf, and the ſum of theſe is the preſent worth ſought. The former example done in this way follows.

1.2762815625) 40.000000000	(31.3410
1.21550625) 40.0000000	(32.9080
1.157625) 40.00000	(34.5535
1.1025) 40.000	(36.2811
1.05) 40.0	(38.0952
Preſent worth,	173.1788

If the annuity to be purchaſed be in reverſion, find firſt the preſent worth of the annuity, as commencing immediately, by any of the methods taught above ; and then, by compound intereſt, find the preſent worth of that preſent worth, rebating for the time in reverſion ; and this laſt preſent worth is the anſwer.

Examp. What is the preſent worth of a yearly penſion or rent of 75 l. to continue 4 years, but not to commence till 3 years hence, diſcounting at 5 *per cent?*

.05 : 1 :: 75 : 1500
1.05×1.05×1.05×1.05 = 1.21550625
1.21550625)1500.00000(1234.05371
1500
1234.05371

265.94629, preſent worth of the annuity, if it was to commence immediately.

1.05×1.05×1.05 = 1.157625 *L. s. d.*
1.157625)265.94629(229.7344 = 229 14 8¼

Prob. 3. Preſent worth, rate and time given, to find the annuity.

Rule. By the preceding problem, find the preſent worth of 1 l. annuity for the rate and time given ; and then ſay, As the preſent worth thus found to 1 l. annuity, ſo the preſent worth given to its annuity ; that is, divide the given preſent worth by that of 1 l. annuity.

Examp. What annuity, to continue 5 years, will 173l. 3s. 7d. purchaſe, allowing compound intereſt at 5 *per cent.*

.05 : 1 :: 1 : 20l.
1.05×1.05×1.05×1.05×1.05 = 1.2762815625
1.2762815625)20.0000000(15.6705.
20
15.6705.

4.3295 preſent worth of 1 l. annuity
4.329)173.179(40l. annuity. *Anſ.*

II. *Annuities for ever, or freehold Eſtates.*

In freehold eſtates, commonly called *annuities in fee-ſimple,* the things chiefly to be conſidered are, 1. The annuity or yearly rent. 2. The price or preſent worth. 3. The rate of intereſt. The queſtions that uſually occur on this head will fall under one or other of the following problems.

Prob. 1. Annuity and rate of intereſt given to find the price.

As the rate of 1 l. to 1 l. ſo the rent to the price.

Examp. The yearly rent of a ſmall eſtate is 40l : What is it worth in ready money, computing intereſt 3½ *per cent?*

As .035 : 1 :: 40 : 1142.857142 = *L.* 1142 17 1½.

Prob. 2. Price and rate of intereſt given, to find the rent or annuity.

As 1 l. to its rate, ſo the price to the rent.

Examp. A gentleman purchaſes an eſtate for 4000l. and has 4½ *per cent.* for his money : Required the rent ?

As 1 : .045 :: 4000 : 1 : 180l. rent ſought.

Prob. 3. Price and rent given, to find the rate of intereſt.

As the price to the rent, ſo 1 to the rate.

Examp. An eſtate of 180l. yearly rent is bought for 4000l. : What rate of intereſt has the purchaſer for his money ?

As 4000 : 180 :: 1 :.045 rate ſought.

Prob.

PROB. 4. The rate of interest given, to find how many years purchase an estate is worth.

Divide 1 by the rate, and the quot is the number of years purchase the estate is worth.

EXAMP. A gentleman is willing to purchase an estate, provided he can have $2\frac{1}{2}$ *per cent.* for his money: How many years purchase may he offer?

.025)1.000(40 years purchase. *Ans.*

PROB. 5. The number of years purchase, at which an estate is bought or sold, given, to find the rate of interest.

Divide 1 by the number of years purchase, and the quot is the rate of interest.

EXAMP. A gentleman gives 40 years purchase for an estate: What interest has he for his money?

40)1.000(.025 rate sought.

The computations hitherto are all performed by a single division or multiplication, and it will scarcely be perceived that the operations are conducted by the rules of compound interest; but when a reversion occurs, recourse must be had to tables of annuities on compound interest.

PROB. 6. The rate of interest, and the rent of a freehold estate in reversion, given, to find the present worth or value of the reversion.

By Prob 1. find the price or present worth of the estate, as if possession was to commence presently; and then, by the Tables, find the present value of the given annuity, or rent, for the years prior to the commencement; subtract this value from the former value, and the remainder is the value of the reversion.

EXAMP. A has the possession of an estate of 130l. *per annum*, to continue 20 years; B has the reversion of the same estate from that time for ever: What is the value of the estate, what the value of the 20 years possession, and what the value of the reversion, reckoning compound interest at 6 *per cent*?

By Prob. 1. .06)130.00($2166.\dot{6}666$ value of the estate.
By Tables, 1491.0896 val. of the possession.

675.5770 value of the reversion.

PROB. 7. The price or value of a reversion, the time prior to the commencement, and rate of interest, given, to find the annuity or rent.

By the Tables, find the amount of the price of the reversion for the years prior to the commencement; and then by Prob. 3. find the annuity which that amount will purchase.

EXAMP. The reversion of a freehold estate, to commence 20 years hence, is bought for 675.577l. compound interest being allowed at 6 *per cent.*: Required the annuity or rent?

By the Tables the amount of 675.577l. for 20 years, at 6 *per cent* is } *L.* $2166.\dot{6}$

By Prob. 2. $2166.\dot{6}\times.06 = 130.0$ rent sought.

III. *Life Annuities.*

THE value of annuities for life is determined from observations made on the bills of mortality. Dr Halley, Mr Simpson, and Monf. de Moivre, are gentlemen of distinguished merit in calculations of this kind.

Dr Halley had recourse to the bills of mortality at Breslaw, the capital of Silesia, as a proper standard for the other parts of Europe, being a place pretty central, at a distance from the sea, and not much crowded with traffickers or foreigners. He pitches upon 1000 persons all born in one year, and observes how many of these were alive every year, from their birth to the extinction of the last, and consequently how many died each year, as in the first of the following tables; which is well adapted to Europe in general. But in the city of London, there is observed to be a greater disparity in the births and burials than in any other place, owing probably to the vast resort of people thither, in the way of commerce, from all parts of the known world. Mr Simpson, therefore, in order to have a table particularly suited to this populous city, pitches upon 1280 persons all born in the same year, and records the number remaining alive each year till none were in life.

It may not be improper, however, to observe, that however perfect tables of this sort may be in themselves, and however well adapted to any particular climate, yet the conclusions deduced from them must always be uncertain, being nothing more than probabilities, or conjectures drawn from the usual period of human life. And the practice of buying and selling annuities on lives, by rules founded on such principles, may be justly considered as a sort of lottery or chance-work, in which the parties concerned must often be deceived. But as estimates and computations of this kind are now become fashionable, we shall subjoin some brief account of such as appear most material.

Dr Halley's Table on the bills of mortality at Breslaw.

Age.	*Perf. liv.*	*A.*	*Perf. liv.*	*A.*	*Perf. liv.*	*A.*	*Perf. liv.*
1	1000	24	573	47	377	70	142
2	855	25	567	48	367	71	131
3	798	26	560	49	357	72	120
4	760	27	553	50	346	73	109
5	732	28	546	51	335	74	98
6	710	29	539	52	324	75	88
7	692	30	531	53	313	76	78
8	680	31	523	54	302	77	68
9	670	32	515	55	292	78	58
10	661	33	507	56	282	79	49
11	653	34	499	57	272	80	41
12	646	35	490	58	262	81	34
13	640	36	481	59	252	82	28
14	634	37	472	60	242	83	23
15	628	38	463	61	232	84	20
16	622	39	454	62	222	85	15
17	616	40	445	63	212	86	11
18	610	41	436	64	202	87	8
19	604	42	427	65	192	88	5
20	598	43	417	66	182	89	3
21	592	44	407	67	172	90	1
22	586	45	397	68	162	91	0
23	579	46	387	69	152		

Annuity.

Mr Simpson's Table on the bills of mortality at London.

Age.	Perf. liv.	A.	Perf. liv.	A.	Perf. liv.	A.	Perf. liv.
0	1280	24	434	48	220	72	59
1	870	25	426	49	212	73	54
2	700	26	418	50	204	74	49
3	635	27	410	51	196	75	45
4	600	28	402	52	188	76	41
5	580	29	394	53	180	77	38
6	564	30	385	54	172	78	35
7	551	31	376	55	165	79	32
8	541	32	367	56	158	80	29
9	532	33	358	57	151	81	26
10	524	34	349	58	144	82	23
11	517	35	340	59	137	83	20
12	510	36	331	60	130	84	17
13	504	37	322	61	123	85	14
14	498	38	313	62	117	86	12
15	492	39	304	63	111	87	10
16	486	40	294	64	105	88	8
17	480	41	284	65	99	89	6
18	474	42	274	66	93	90	5
19	468	43	264	67	87	91	4
20	462	44	255	68	81	92	3
21	455	45	246	69	75	93	2
22	448	46	237	70	69	94	1
23	441	47	228	71	64	95	0

From the preceding tables the probability of the continuance or extinction of human life is estimated as follows.

1. The probability that a person of a given age shall live a certain number of years, is measured by the proportion which the number of persons living at the proposed age has to the difference betweeen the said number and the number of persons living at the given age.

Thus, if it be demanded, what chance a person of 40 years has to live seven years longer? from 445, the number of persons living at 40 years of age in Dr Halley's table, subtract 377, the number of persons living at 47 years of age, and the remainder 68, is the number of persons that died during these 7 years; and the probability or chance that the person in the question shall live these 7 years is as 377 to 68, or nearly as $5\frac{1}{2}$ to 1. But, by Mr Simpson's table, the chance is something less than that of 4 to 1.

2. If the year to which a person of a given age has an equal chance of arriving before he dies, be required, it may be found thus: Find half the number of persons living at the given age in the tables, and in the column of age you have the year required.

Thus, if the question be put with respect to a person of 30 years of age, the number of that age in Dr Halley's table is 531, the half whereof is 265, which is found in the table between 57 and 58 years; so that a person of 30 years has an equal chance of living between 27 and 28 years longer.

3. By the tables, the premium of insurance upon lives may in some measure be regulated.

Thus, the chance that a person of 25 years has to live another year, is, by Dr Halley's table, as 80 to 1; but the chance that a person of 50 years has to live a year longer is only 30 to 1. And, consequently, the premium for insuring the former ought to be to the premium for insuring the later for one year, as 30 to 80, or as 3 to 8.

Annuity.

Prob. I. To find the value of an annuity of 1 l. for the life of a single person of any given age.

Monf. de Moivre, by observing the decrease of the probabilities of life, as exhibited in the table, composed an algebraic theorem or canon, for computing the value of an annuity for life; which canon we here lay down by way of

Rule. Find the complement of life; and, by the tables, find the value of 1 l. annuity for the years denoted by the said complement; multiply this value by the amount of 1 l. for a year, and divide the product by the complement of life; then subtract the quot from 1; divide the remainder by the interest of 1 l. for a year; and this last quot will be the value of the annuity sought, or, in other words, the number of years purchase the annuity is worth.

Examp. What is the value of an annuity of 1 l. for an age of 50 years, interest at 5 *per cent.*?

86
50 are given.

36 complement of life.

By the tables, the value is, 16.5468
Amount of 1 l. for a year, 1.05

827340
165468

Complement of life, 36)17.374140(.482615
From unity, viz. 1.000000
Subtract .482615

Interest of 1 l. .05).517385(10.3477 value sought.

By the preceding problem is constructed the following table.

The

The value of 1 l. annuity for a single life.

Age.	3 *per c.*	$3\frac{1}{2}$ *per c.*	4 *per c.*	$4\frac{1}{2}$ *per c.*	5 *per c.*	6 *per c.*
9=10	19.87	18.27	16.88	15.67	14.60	12.80
8=11	19.74	18.16	16.79	15.59	14.53	12.75
7=12	19.60	18.05	16.64	15.51	14.47	12.70
13	19.47	17.94	16.60	15.43	14.41	12.65
6=14	19.33	17.82	16.50	15.35	14.34	12.60
15	19.19	17.71	16.41	15.27	14.27	12.55
16	19.05	17.59	16.31	15.19	12.20	12.50
5=17	18.90	17.46	16.21	15.10	14.12	12.45
18	18.76	17.33	16.10	15.01	14.05	12.40
19	18.61	17.21	15.99	14.92	13.97	12.35
4=20	18.46	17.09	15.89	14.83	13.89	12.30
21	18.30	16.96	15.78	14.73	13.81	12.20
22	18.15	16.83	15.67	14.64	13.72	12.15
23	17.99	16.69	15.55	14.54	13.64	12.10
3=24	17.83	16.56	15.43	14.44	13.55	12.00
25	17.66	16.42	15.31	14.34	13.46	11.95
26	17.50	16.28	15.19	14.23	13.37	11.90
27	17.33	16.13	15.04	14.12	13.28	11.80
28	17.16	15.98	14.94	14.02	13.18	11.75
29	16.98	15.83	14.81	13.90	13.09	11.65
30	16.80	15.68	14.68	13.79	12.99	11.60
2=31	16.62	15.53	14.54	13.67	12.88	11.50
32	16.44	15.37	14.41	13.55	12.78	11.40
33	16.25	15.21	14.27	13.43	12.67	11.35
34	16.06	15.05	14.12	13.30	12.56	11.25
35	15.86	14.89	13.98	13.17	12.45	11.15
36	15.67	14.71	13.82	13.04	12.33	11.05
37	15.46	14.52	13.67	12.90	12.21	11.00
38	15.29	14.34	13.52	12.77	12.09	10.90
1=39	15.05	14.16	13.36	12.63	11.96	10.80
40	14.84	13.98	13.20	12.48	11.83	10.70
41	14.63	13.79	13.02	12.33	11.70	10.55
42	14.41	13.59	12.85	12.18	11.57	10.45
43	14.19	13.40	12.68	12.02	11.43	10.35
44	13.96	13.20	12.50	11.87	11.29	10.25
45	13.73	12.99	12.32	11.70	11.14	10.10
46	13.49	12.78	12.13	11.54	10.99	10.00
47	13.25	12.56	11.94	11.37	10.84	9.85
48	13.01	12.36	11.74	11.19	10.68	9.75
49	12.76	12.14	11.54	11.00	10.51	9.60
50	12.51	11.92	11.34	10.82	10.35	9.45
51	12.26	11.69	11.13	10.64	10.17	9.30
52	12.00	11.45	10.92	10.44	9.99	9.20
53	11.73	11.20	10.70	10.24	9.82	9.00
54	11.46	10.95	10.47	10.04	9.63	8.85
55	11.18	10.69	10.24	9.82	9.44	8.70
56	10.90	10.44	10.01	9.61	9.24	8.55
57	10.61	10.18	9.77	9.39	9.04	8.35
58	10.32	9.91	9.52	9.16	8.83	8.20
59	10.03	9.64	9.27	8.93	8.61	8.00
60	9.73	9.36	9.01	8.69	8.39	7.80

The value of 1 l. annuity for a single life.

A.	3 *per c.*	$3\frac{1}{2}$ *per c.*	4 *per c.*	$4\frac{1}{2}$ *per c.*	5 *per c.*	6 *per c.*
61	9.42	9.08	8.75	8.44	8.16	7.60
62	9.11	8.79	8.48	8.19	7.93	7.40
63	8.79	8.49	8.20	7.94	7.68	7.30
64	8.46	8.19	7.92	7.67	7.43	6.95
65	8.13	7.88	7.63	7.39	7.18	6.75
66	7.79	7.56	7.33	7.12	6.91	6.50
67	7.45	7.24	7.02	6.83	6.64	6.25
68	7.10	6.91	6.75	6.54	6.36	6.00
69	6.75	6.57	6.39	6.23	6.07	5.75
70	6.38	6.22	6.06	5.92	5.77	5.50
71	6.01	5.87	5.72	5.59	5.47	5.20
72	5.63	5.51	5.38	5.26	5.15	4.90
73	5.25	5.14	5.02	4.92	4.82	4.60
74	4.85	4.77	4.66	4.57	4.49	4.30
75	4.45	4.38	4.29	4.22	4.14	4.00
76	4.05	3.98	3.91	3.84	3.78	3.65
77	3.63	3.57	3.52	3.47	3.41	3.30
78	3.21	3.16	3.11	3.07	3.03	2.95
79	2.78	2.74	2.70	2.67	2.64	2.55
80	2.34	2.31	2.28	2.26	2.23	2.15

The above table shows the value of an annuity of one pound for a single life, at all the current rates of interest; and is esteemed the best table of this kind extant, and preferable to any other of a different construction. But yet those who sell annuities have generally one and a half or two years more value, than specified in the table, from purchasers whose age is 20 years or upwards.

Annuities of this sort are commonly bought or sold at so many years purchase; and the value assigned in the table may be so reckoned. Thus the value of an annuity of one pound for an age of 50 years, at 3 *per cent.* interest is 12.51; that is 12l. 10s. or twelve and a half years purchase. The marginal figures on the left of the column of age serve to shorten the table, and signify, that the value of an annuity for the age denoted by them, is the same with the value of an annuity for the age denoted by the numbers before which they stand. Thus the value of an annuity for the age of 9 and 10 years is the same; and the value of an annuity for the age of 6 and 14, for the age of 3 and 24, &c. is the same. The further use of the table will appear in the questions and problems following.

QUEST. 1. A person of 50 years would purchase an annuity for life of 200l.: What ready money ought he to pay, reckoning interest at $4\frac{1}{2}$ *per cent.*?

L.

By the table the value of 1 l. is 10.8
Multiply by 200

Value to be paid in ready money 2164.00 *Ans.*

QUEST. 2. A young merchant marries a widow lady of 40 years of age, with a jointure of 300l. a-year, and wants to dispose of the jointure for ready money: What sum ought he to receive, reckoning interest at $3\frac{1}{2}$ *per cent.*?

By

Annuity.

	L.
By the table the value of 1 l. is	13.98
	300
Value to be received in ready money	4194:00 *Anſ.*

PROB. 2. To find the value of an annuity for the joint continuance of two lives, one life failing, the annuity to ceaſe.

Here there are two caſes, according as the ages of the two perſons are equal or unequal.

1. If the two perſons be of the ſame age, work by the following

RULE. Take the value of any one of the lives from the table; multiply this value by the intereſt of 1 l. for a year; ſubtract the product from 2; divide the foreſaid value by the remainder; and the quot will be the value of 1 l. annuity, or the number of years purchaſe ſought.

EXAMP. What is the value of 100l. annuity for the joint lives of two perſons, of the age of 30 years each, reckoning intereſt at 4 *per cent?*

By the table, one life of 30 years is	14.68
Multiply by	.04
Subtract the product	5872
From	2.0000
Remains	1.4128

And 1.4128) 14.68 (10.39 value of 1l. annuity.

And 10.39×100=1039 the value ſought.

2. If the two perſons are of different ages, work as directed in the following

RULE. Take the values of the two lives from the table; multiply them into one another, calling the reſult the firſt product; then multiply the ſaid firſt product by the intereſt of 1 l. for a year, calling the reſult the ſecond product; add the values of the two lives, and from their ſum ſubtract the ſecond product; divide the firſt product by the remainder, and the quot will be the value of 1 l. annuity, or the number of years-purchaſe ſought.

EXAMP. What is the value of 70l. annuity for the joint lives of two perſons, whereof one is 40 and the other 50 years of age, reckoning intereſt at 5 *per cent?*

By the table the value of 40 years is	11.83
And the value of 50 years is	10.35
Firſt product,	122.4405
Multiply by	.05
Second product,	6.122025
Sum of the two lives,	22.180000
Second product deduct,	6.122025
Remainder,	16.057975

And 16.057975) 122.4405 (7.62 value of 1 l. annuity.
70

533.40 value ſought.

PROB. 3. To find the value of an annuity upon the longeſt of two lives; that is, to continue ſo long as either of the perſons is in life.

RULE. From the ſum of the values of the ſingle lives ſubtract the value of the joint lives, and the remainder will be the value ſought.

EXAMP. What is the value of an annuity of 1 l. upon the longeſt of two lives, the one perſon being 30, and the other 40 years of age, intereſt at 4 *per cent?*

By the table, 30 years is	14.68
40 years is	13.20
	27.88
Value of their joint lives, by Prob. 2. Caſe 2. is,	9.62
Value ſought,	18.26

If the annuity be any other than 1 l. multiply the anſwer found as above by the given annuity.

If the two perſons be of equal age, find the value of their joint lives by Caſe 1. of Prob. 2.

PROB. 4. To find the value of the next preſentation to a living.

RULE. From the value of the ſucceſſor's life ſubtract the joint value of his and the incumbent's life, and the remainder will be the value of 1 l. annuity; which multiplied by the yearly income, will give the ſum to be paid for the next preſentation.

EXAMP. A enjoys a living of 100l. *per annum*, and B would purchaſe the ſaid living for his life after A's death: The queſtion is, What he ought to pay for it, reckoning intereſt at 5 *per cent*. A being 60, and B 25 years of age?

	L.
By the table, B's life is	13.46
Joint value of both lives, by Prob. 2. is	6.97
The value of 1 l. annuity,	6.49
Multiply by	100
Value of next preſentation,	649.00

The value of a direct preſentation is the ſame as that of any other annuity for life, and is found for 1 l. by the table; which being multiplied by the yearly income, gives the value ſought.

PROB. 5. To find the value of a reverſion for ever, after two ſucceſſive lives; or to find the value of a living after the death of the preſent incumbent and his ſucceſſor.

RULE. By Prob 3. find the value of the longeſt of the two lives, and ſubtract that value from the value of the perpetuity, and the remainder will be the value ſought.

EXAMP. A, aged 50, enjoys an eſtate or living of 100l. *per annum;* B, aged 30, is entitled to his lifetime of the ſame eſtate after A's death; and it is propoſed to ſell the eſtate juſt now with the burden of A and B's lives on it: What is the reverſion worth, reckoning intereſt at 4 *per cent?*

	L.
By the table, A's life of 50 is	11.34
B's life of 30 is	14.68
Sum,	26.02
Value of their joint lives, found by Prob. 2. Caſe 2. is	8.60
Value of the longeſt life,	17.42ſub.
From the value of the perpetuity,	25.00
Remains the value of 1 l. reverſion,	7.58
Multiply by	100
Value of the reverſion,	758.00

PROB.

Prob. 6. To find the value of the joint continuance of three lives, one life failing, the annuity to ceaſe.

Rule. Find the ſingle values of the three lives from the table; multiply theſe ſingle values continually, calling the reſult the product of the three lives; multiply that product by the intereſt of 1 l. and that product again by 2, calling the reſult the double product; then, from the ſum of the ſeveral products of the lives, taken two and two, ſubtract the double product; divide the product of the three lives by the remainder, and the quot will be the value of the three joint lives.

Examp. A is 18 years of age; B 34, and C 56: What is the value of their joint lives, reckoning intereſt at 4 *per cent.*?

By the table, the value of A's life is 16.1, of B's 14.12, and of C's 10.01.

$16.1 \times 14.12 \times 10.01 = 2275.6$, product of the three lives,
.04

91.024
2

182.048, double product.

Product of A and B,	$16.1 \times 14.12 \times$	227.33
A and C,	$16.1 \times 10.01 =$	161.16
B and C,	$14.12 \times 10.00 =$	141.34
Sum of all, two and two,	-	529.83
Double product ſubtract	- -	182.048
Remainder	-	347.782

And 347.782)2275.600(6.54 value ſought.

Prob. 7. To find the value of an annuity upon the longeſt of three lives.

Rule. From the ſum of the values of the three ſingle lives taken from the table, ſubtract the ſum of all the joint lives, taken two and two, as found by Prob. 2. and to the remainder add the value of the three joint lives, as found by Prob 6. and that ſum will be the value of the longeſt life ſought.

Examp. A is 18 years of age, B 34, and C 56: What is the value of the longeſt of theſe three lives, intereſt at 4 *per cent*?

By the table, the ſingle value of A's life is	16.1
ſingle value of B's life is	14.12
ſingle value of C's life is	10.01
Sum of the ſingle values,	40.23
By Prob. 2. the joint value of A and B is	10.76
joint value of A and C is	8.19
joint value of B and C is	7.65
Sum of the joint lives,	26.60
Remainder, -	13.63
By Prob. 6. the value of the 3 joint lives is	6.54
Value of the longeſt of the 3 lives,	20.17

Other problems might be added, but theſe adduced are ſufficient for moſt purpoſes. The reader probably may wiſh that the reaſon of the rules, which, it muſt be owned, are intricate, had been aſſigned; but this could not be done without entering deeper into the ſubject than was practicable in this place. See Chances.

Annuities (Borrowing upon); one of the methods employed by government for raiſing ſupplies.

Of this there are two methods; that of borrowing upon annuities for terms of years, and that of borrowing upon annuities for lives.

During the reigns of king William and queen Anne, large ſums were frequently borrowed upon annuities for terms of years, which were ſometimes longer and ſometimes ſhorter. In 1693, an act was paſſed for borrowing one million upon an annuity of 14 *per cent*. or of 140,000*l*. a year for 16 years. In 1691, an act was paſſed for borrowing a million upon annuities for lives, upon terms which in the preſent times would appear very advantageous. But the ſubſcription was not filled up. In the following year the deficiency was made good by borrowing upon annuities for lives at 14 *per cent*., or at little more than ſeven years purchaſe. In 1695, the perſons who had purchaſed thoſe annuities were allowed to exchange them for others of 96 years, upon paying into the exchequer 63 pounds in the hundred; that is, the difference between 14 *per cent*. for life, and 14 *per cent*. for 96 years, was ſold for 63 pounds, or for four and a half years purchaſe. Such was the ſuppoſed inſtability of government, that even theſe terms procured few purchaſers. In the reign of queen Anne, money was upon different occaſions borrowed both upon annuities for lives and upon annuities for terms of 32, of 89, of 98, and of 99 years. In 1719, the proprietors of the annuities for 32 years were induced to accept in lieu of them South Sea ſtock to the amount of eleven and a half years purchaſe of the annuities, together with an additional quantity of ſtock equal to the arrears which happened then to be due upon them. In 1720, the greater part of the other annuities for terms of years both long and ſhort were ſubſcribed into the ſame fund. The long annuities at that time amounted to 666,821*l*. 8*s*. $3\frac{1}{2}$*d*. a year. On the 5th of January, 1775, the remainder of them, or what was not ſubſcribed at that time, amounted only to 136,453*l*. 12*s*. 8*d*.

During the two wars which begun in 1739 and in 1755, little money was borrowed either upon annuities for terms of years, or upon thoſe for lives. An annuity for 98 or 99 years, however, is worth nearly as much money as a perpetuity, and ſhould, therefore, one might think, be a fund for borrowing nearly as much. But thoſe who, in order to make family ſettlements, and to provide for remote futurity, buy into the public ſtocks, would not care to purchaſe into one of which the value was continually diminiſhing; and ſuch people make a very conſiderable proportion both of the proprietors and purchaſers of ſtock. An annuity for a long term of years, therefore, though its intrinſic value may be very nearly the ſame with that of a perpetual annuity, will not find nearly the ſame number of purchaſers. The ſubſcribers to a new loan, who mean generally to ſell their ſubſcription as ſoon as poſſible, prefer greatly a perpetual annuity redeemable by parliament, to an irredeemable annuity for a long term of years of only equal amount. The value of the former may be ſuppoſed always the ſame, or very nearly the ſame; and it makes, therefore, a more convenient transferable ſtock than the latter.

During the two laſt mentioned wars, annuities, either for terms of years or for lives, were ſeldom granted but as premiums to the subscribers to a new loan, over and above the redeemable annuity or interest upon the credit of which the loan was supposed to be made. They were granted, not as the proper fund upon which the money was borrowed; but as an additional encouragement to the lender.

Annuities for lives have occasionally been granted in two different ways; either upon separate lives, or upon lots of lives, which in French are called *Tontines*, from the name of their inventor. When annuities are granted upon separate lives, the death of every individual annuitant disburthens the public revenue so far as it was affected by his annuity. When annuities are granted upon tontines, the liberation of the public revenue does not commence till the death of all the annuitants comprehended in one lot, which may sometimes consist of twenty or thirty persons, of whom the survivors succeed to the annuities of all those who die before them; the last survivor succeeding to the annuities of the whole lot. Upon the same revenue more money can always be raised by tontines than by annuities for separate lives. An annuity, with a right of survivorship, is really worth more than an equal annuity for a separate life, and from the confidence which every man naturally has in his own good fortune, the principle upon which is founded the success of all lotteries, such an annuity generally sells for something more than it is worth. In countries where it is usual for government to raise money by granting annuities, tontines are upon this account generally preferred to annuities for separate lives. The expedient which will raise most money, is almost always preferred to that which is likely to bring about in the speediest manner the liberation of the public revenue.

In France a much greater proportion of the public debts consists in annuities for lives than in England. According to a memoir presented by the parliament of Bourdeaux to the king in 1764, the whole public debt of France is estimated at twenty-four hundred millions of livres; of which the capital for which annuities for lives had been granted, is supposed to amount to three hundred millions, the eighth-part of the whole public debt. The annuities themselves are computed to amount to thirty millions a-year, the fourth part of one hundred and twenty millions, the supposed interest of that whole debt. It is not the different degrees of anxiety in the two governments of France and England for the liberation of the public revenue, which occasions this difference in their respective modes of borrowing; it arises altogether from the different views and interests of the lenders.

In Britain, the seat of government being in the greatest mercantile city in the world, the merchants are generally the people who advance money to government. By advancing it they do not mean to diminish; but, on the contrary, to increase their mercantile capitals; and unless they expected to sell with some profit their share in the subscription for a new loan, they never would subscribe. But if by advancing their money they were to purchase, instead of perpetual annuities, annuities for lives only, whether their own or those of other people, they would not always be so likely to sell them with a profit. Annuities upon their own lives they would always sell with loss; because no man will give for an annuity upon the life of another whose age and state are nearly the same with their own, the same price which he would give for one upon his own. An annuity upon the life of a third person, indeed, is, no doubt, of equal value to the buyer and the seller; but its real value begins to diminish from the moment it is granted, and continues to do so more and more as long as it subsists. It can never, therefore, make so convenient a transferable stock as a perpetual annuity, of which the real value may be supposed always the same, or very nearly the same.

In France, the seat of government not being in a great mercantile city, merchants do not make so great a proportion of the people who advance money to government. The people concerned in the finances, the farmers-general, the receivers of the taxes which are not in farm, the court-bankers, &c. make the greater part of those who advance their money in all public exigencies. Such people are commonly men of mean birth, but of great wealth, and frequently of great pride. They are too proud to marry their equals, and women of quality disdain to marry them. They frequently resolve, therefore, to live bachelors; and having neither any families of their own, nor much regard for those of their relations, whom they are not always very fond of acknowledging, they desire only to live in splendour during their own time, and are not unwilling that their fortune should end with themselves. The number of rich people, besides, who are either averse to marry, or whose condition of life renders it either improper or inconvenient for them to do so, is much greater in France than in England. To such people, who have little or no care for posterity, nothing can be more convenient than to exchange their capital for a revenue, which is to last just as long, and no longer than they wish it to do.

ANNUITY of Tiends, in Scots law, a certain proportion of the tiends of erected benefices formerly payable to the crown, but now gone into disuse.

ANNULAR, in a general sense, something in the form of, or resembling, a ring. It is also a peculiar denomination of the fourth finger, commonly called the *ring-finger*.

ANNULET, in architecture, a small square member in the Doric capital, under the quarter-round.

Annulet is also a narrow flat moulding, which is common to divers places of the columns, as in the bases, capitals, &c. It is the same member which Vitruvius calls a *fillet*; Palladio, a *listil* or *cincture*; Scamozzi, and Mr Brown, a *supercilium*, *list*, *timea*, *eye-brow*, *square rabbit*. See Architecture.

Annulet, a little circle, borne as a charge in coats-of-arms, as also added to them as a *difference*. Among the Romans it represented liberty and nobility. It also denotes strength and eternity, by reason of its circular form.

When this figure is added as a difference, some authors assert, that it serves to remind the bearer to atchieve great actions.

ANNULLING, a term sometimes used for cancelling or making void a deed, sentence, or the like.

ANNUNCIADA, Annuntiada, or Annuntiata, an order of knighthood in Savoy, first instituted by Amadeus I. in the year 1409: their collar was of 15 links, interwoven one with another, in form of a true-lover's knot; and the motto, F. E. R. T. signifying, *Fortitudo ejus Rhodum tenuit.* Amadeus VIII. gave the name *Annunciada* to this order, which was formerly known by that of *the knot of love;* changing at the same time the image of St Maurice patron of Savoy, which hung at the collar, for that of the Virgin Mary; and, instead of the motto above-mentioned, substituting the words of the angel's salutation.

ANNUNCIADA is also the title of several religious orders, instituted at different times, and at different places, in honour of the annunciation. See the next article.

ANNUNCIATION, the tidings brought by the angel Gabriel to the Virgin Mary of the incarnation of Christ.

ANNUNCIATION is also a festival kept by the church on the 25th of March, in commemoration of these tidings. This festival appears to be of very great antiquity. There is mention made of it in a sermon which goes under the name of *Athanasius*. Others carry it up to the time of Gregory Thaumaturgus, because there is a sermon likewise attributed to him upon the same subject. But the best critics reject both these writings as spurious. However, it is certain this festival was observed before the time of the council of Trullo, in which there is a canon forbidding the celebration of all festivals in lent, excepting the Lord's day, and the feast of the annunciation: so that we may date its original from the seventh century.

In the Romish church, on this feast, the pope performs the ceremony of marrying or cloystering a certain number of maidens, who are presented to him in the church, clothed in white serge, and muffled up from head to foot: An officer stands by, with purses containing notes of fifty crowns for those who make choice of marriage, and notes of a hundred for those who choose to veil.

ANNUNCIATION is likewise a title given by the Jews to part of the ceremony of the passover.

ANNUNCIATOR, the name of an officer in the church of Constantinople. It was his business to inform the people of the festivals that were to be celebrated.

ANODYNE (from α privative, and οδυνω, *doleo;* or α neg. and ωδυνη, *pain);* a term applied to medicines which ease pain, and procure sleep. They are divided into three sorts, *viz.* 1. Paregorics, or such as assuage pain. 2. Hypnotics, or such as relieve by procuring sleep. 3. Narcotics, or such as ease the patient by stupifying him.

Opiates and Narcotics destroy sensation. Some hypnotics annd paregorics, as nitre, camphor, &c. procure ease and sleep by removing the offending cause. Camphor is said to be the best anodyne in nervous cases and at the decline of fevers. The doses of these medicines are generally regulated by the pulse.

ANNOINTERS, a religious sect in some parts of England, so called from the ceremony they used of anointing all persons before they admitted them into their church. They founded their opinion of anointing upon the fifth of James, verses 14 and 15.

ANOLYMPIADES, in antiquity, a name given by the Elians to those Olympic games which had been celebrated under the direction of the Pisæans and Arcadians. The Elians claimed the sole right of managing the Olympic games, in which they sometimes met with competitors. The hundred and fourth Olympiad was celebrated by order of the Arcadians, by whom the Elians were at that time reduced very low: this, as well as those managed by the inhabitants of Pisa, they called ανολυμπιαδας, that is, "unlawful Olympiads; and left them out of their annals, wherein the names of their victors and other occurrences were registered.

ANOMALISTICAL YEAR, in astronomy, the time that the earth takes to pass through her orbit: it is also called the *Periodical Year*. The space of time belonging to this year is greater than the tropical year, on account of the procession of the equinoxes. See ASTRONOMY.

ANOMALOUS, a term applied to whatever is irregular, or deviates from the rule observed by other things of the like nature.

ANOMALOUS *Verbs*, in grammar, such as are not conjugated conformably to the paradigm of their conjugation. They are found in all languages. In Latin, the verb *lego* is the paradigm of the third conjugation; and runs thus, *lego, legis, legit:* By the same rule it should be *fero, feris, ferit;* but we say *fero, fers, fert: fero*, then, is an anomalous verb. In English the irregularity relates often to the preter tense and passive participle: for example, *give*, were it formed according to rule, would make *gived* in the preter tense and passive participle: whereas in the former, it makes *gave*, and in the latter *given*.

ANOMALY, in astronomy, an irregularity in the motion of the planets, whereby they deviate from the aphelion or apogee.

ANOMIA, in zoology, a genus of insects belonging to the order of vermes testacea. The shell is bivalve, and the valves are unequal. One valve is perforated near the hinge; affixed by that perforation to some other body. There are 25 species of the anomia; of which only two are natives of the British seas, *viz.* 1. The ephippium, with the habit of an oyster; the one side convex, the other flat; perforated; adherent to other bodies, often to oyster-shells, by a strong tendinous ligature; colour of the inside perlaceous. Size near two inches diameter. 2. The squammula, with shells resembling the scales of fish; very delicate, and silvery; much flatted; perforated; very small. Adheres to oysters, crabs, lobsters, and shells. The species of this genus are commonly called *Beaked cockles*. No name has been given to the fish that inhabit it; for the recent shells of this kind are so very rare, that there is scarcely one to be found perfect. They are perhaps, as well as that which has given its form to the *cornu amonis*, inhabitants of the deepest parts of the ocean; consequently it must be some extraordinary agitation of that great body of water that can bring them at all to our knowledge in their recent state.

The fossile species of the *Anomia* genus are uncommonly numerous in this island, in our chalk-pits and limestone quarries; and, in Gloucestershire, they are as common on the ploughed land as pebbles in other places.

ANOMOEANS, in ecclesiastical history, the name by which the pure Arians were called in the fourth century, in contradistinction to the Semi-Arians. The word is formed from the Greek, ανομοιος, *different, dissimilar:* For the pure Arians asserted, that the Son was of a nature different from, and in nothing like that of the Father: whereas the Semi-Arians acknowledged a likeness of nature in the Son; at the same time that they denied, with the pure Arians, the consubstantiality of the World.—The Semi-Arians condemned the Anomœans in the council of Seleucia; and the Anomœans in their turn condemned the Semi-Arians in the councils of Constantinople and Antioch, erasing the word ὁμοιος, *like*, out of the Formula of Rimini and that of Constantinople.

ANOMORHOMBOIDIA, in natural history, the name of a genus of spars; the word is derived from the Greek ανωμαλης *irregular*, and ρομβοειδης a *rhomboidal* figure. The bodies of this genus are pellucid crystalline spars of no determinate or regular external form, but always breaking into regularly rhomboidal masses; easily fissile, and composed of plates running both horizontally and perpendicularly thro' the masses, but cleaving more readily and evenly in an horizontal, than in a perpendicular direction: the plates being ever composed of irregular arrangements of rhomboidal concretions. Of this genus there are five known species. 1. A white, bright, and shattery one; found in great quantities in the lead-mines of Derbyshire, Yorkshire, and Wales. 2. A milk-white, opake, and shattery one, found in some parts of France, and very plentifully in Germany, and sometimes in Wales and Scotland, and in the hills of Yorkshire. 3. A hard, dull, and snow-white one, found in some of the mines in Derbyshire, and in many of the northern countries. 4. A hard, grey and pellucid one, found in the lead-mines of Yorkshire, and very common in Germany. And, 5. A pellucid and colourless one; this is found in the lead mines of Derbyshire and Yorkshire. All these in some degree have their double refraction of the island crystal. See *Island-Crystal*.

ANONIS, in botany. See Ononis.

ANONYMOUS, something that is nameless, or of which the name is concealed. It is a term usually applied to books that do not express the author's name, or to authors whose names are unknown.

Anonymous, in Commerce.——Partnerships in trade in France are styled anonymous, when they are not carried on under any particular name, but wherein each of the partners trades visibly on his own account, and in his own name; after which all the partners give one another an account of their profit or loss in trade. These sorts of partnerships are concealed, and known only to the parties themselves.

Anonymous Partnerships in Trade, are also in France such, wherein persons of fortune and quality deposit sums of money, in order to share of the profits and loss. To this end those who furnish the capital have no trouble in carrying on the trade, nor do their names appear to be any way interested therein.

Anonymous, in law. The sending anonymous letters demanding money, &c. is felony by the Black Act, 9. Geo. I. cap. 22.

ANOREXIA, anorexy, (from α neg. and ορεξις, *appetite*); a want of appetite, or a loathing of food. The disorder is either original or symptomatic. When it is original, its causes are, bad diet, too free drinking, voraciousness, &c.: In which cases, a vomit or two of ipecacuanha may be taken; and temperance, a light but cordial nourishing diet, and daily exercise, persisted in, will generally effect a recovery. But it is more frequently a symptom of some other disorder; and then the cure depends on the removal of the original one.

ANOSSI, a province of the island of Madagascar, lying between Lat. 23° 18 and 26° S. It is watered by many rivers, most of which run into the *Franchere*, *Ramevatte*, or *Immour*, the spring of which is in a mountain called *Manghage*, and discharges itself into the sea in Lat. 25. 18 S. The mouth of this river is often stopped, and the course to the sea interrupted, unless kept open by the overflowings of great rains and high tides. The water runs salt one league above the mouth, particularly in a free communication with the sea. A lake, called *Ambou*, is formed at the mouth, half a league wide, with depth sufficient for any ship if the mouth of the river was kept open. Next in bigness to the Franchere is the Manghasia, which springs from a mountain called *Siliva*, and empties itself into the sea, where large ships may ride at anchor. Crocodiles breed in these and all the other rivers of the island.

Between the two rivers above mentioned lies Cape St Romain, half a mile distant from the mouth of the Franchere, and which runs from the north-west six or seven leagues into the sea. When the Cape is passed, the coast forms a great bay, in the shape of a cross, which extends to the mouth of a river called *Dian Panouge*, or *Pitorah*. In the middle of this bay the land runs out, and almost forms a peninsula called *Tholangare*. Fort Dauphin lies to the north of this peninsula, and Port Dauphin over against it. This province has several other peninsulas and small islands belonging to it. The country is beautiful; abounds in fruit-trees; is fertile in pasture for cattle; and, if carefully cultivated, would produce all the necessaries of life. It is surrounded by high mountains, which are covered with woods and shrubs; but, about four miles distant from Fort Dauphin, the adjacent hills are quite destitute of verdure. The French often dug in this neighbourhood, expecting to meet with mines of gold and silver, particularly in one mountain where several springs flow near each other and empty themselves into a neighbouring river. In this river they found several stones and heaps intermixed with yellow clay, with a great quantity of black and white spangles shining like silver, which they carefully pounded and washed, but without effect. About 60 yards above these springs the grass, and every sort of vegetable, appears half dried and yellow, from a metalline sulphur, which gives that aspect; but the top of the mountain is covered with a fresh and beautiful verdure. It is said that the Portuguese found gold at the foot of this mountain on the north side, but that the place they had dug was filled up by the chiefs of the country after the Portuguese had been driven out.

The province of Anossi is inhabited by three different sorts of whites, and four sorts of negroes. The whites are distinguished by the names of *Rohandrians Anacandrians*, and *Ondzatsi*. The whites are distinguished from the negroes by the general name of *Zaferamini*, or *Rahimini*; and the Rohandrians are distinguished above the other whites. When they proceed to an election of a sovereign, whom they call *Ompiandrian*, or *Dian Bahouache*; he is chosen from the Rohandrian race. Next to him the others hold the rank of princes, and are honoured as such by all the rest of the subjects. The Anacandrians are descendants of the chiefs, but who have degenerated, and are accounted the bastards of princes, or those who are descended from a Rohandrian and any inferior white or black woman. These are likewise called by the name of *Ontempassemaca*, or people from the sandy parts of Mecca, from whence, they say, came the Rohandrians. Both the Rohandrians and Anacandrians wear long hair, which hangs down in curls; and enjoy the privilege of killing beasts. The Ondzatsi, or lowest class of whites, are descended from the bastards of the Anacandrians. These are all fishermen, and are allowed to kill no land-animal except a chicken.

The four classes of negroes are named *Voadziri Lohavohits*, *Ontsoa*, and *Ondeves*. The Voadziri, the most powerful and the richest, are masters of several vilages, and descended from the original lords of the country. They enjoy the privilege of killing beasts, when at a distance from the whites, and no Rohandrian or Anacandrian in the village. The Lohavohits are descendants from the Voadziri, and also lords; but with this difference, that the one commands a whole district, and the jurisdiction of the others extends only to their own village and family. They are also permitted to kill those beasts they intend to eat, when at a distance from the whites. The Ontsoa are next to the Lohavohits, and are their near relations. The Ondeves are the lowest of all, being originally slaves by father and mother. The Voadziri, Lohavohits, and Ontsoa, enjoy the privilege of submitting themselves, on the death of their lord or king, to any chief they please. In return for such homage the new lord makes them a present, in consequence of which he becomes heir to all their possessions. Hence the lower classes both of whites and blacks, when death approaches, are under the greatest concern and anguish of mind, well knowing that their lords will not fail to deprive their children of every thing they possess. The Ondeves have not the same liberty with the others: but, in times of famine, the chiefs are obliged to supply them with necessaries; which if they fail to do, they have the liberty of submitting themselves to new masters. The inhabitants of this province have no temples, and very little appearance of religion; only they keep up a custom of immolating beasts upon particular occasions, as in sickness, planting yams or rice, on assemblies, &c. They offer the first-born beast to the devil and to God, naming the devil first, in this manner, *Dianbilis Aminhanhabare*, or "Lord Devil and God."—There are several towns on the river Franchere; and near this river the Portuguese had a fort built upon a steep rock, and several buildings below, with inclosures, which furnished all sorts of necessaries for their subsistence; but they were all massacred by the natives.

This province seems originally to have been inhabited by negroes. The whites or Zaferamini settled in it about 200 years ago, and conquered the negroes. But they themselves were conquered by the French, though under the government of a king whom they honoured as a god. In 1642, Captain Rivault obtained a permission to establish a colony in this part of the island; and accordingly he took possession of it in the name of the king of France, in the month of September, that same year. The French landed 200 men well armed and provided with store of ammunition and other necessaries for building a fort, which they immediately set about; but no sooner did the natives observe their intention, than they used their utmost art to prevent their design from taking effect. This created a war, in which the French were victors; and, the natives becoming in time much better reconciled to them, they intermarried, and lived up and down in several towns at some distance from one another, not above five or six in a place. This tranquillity lasted for some years; but at last the natives, growing jealous, resolved to free themselves from a foreign yoke, and accordingly formed a conspiracy to cut off all the French in one day; which they soon after effected, not leaving a single person alive. In 1644 the above-mentioned Fort Dauphin was erected in Lat. 25. 6. S. Many buildings were erected, behind the Fort, adjoining to the governor's house, with great inclosures that produced every sort of fruit and kitchen herb. In 1656 this fort was accidentally destroyed by fire; but was soon after repaired, and still continues, notwithstanding the catastrophe above mentioned, and its garrison carries on frequent wars with the natives.

ANOTTA, or ARNOTTA, in dyeing, an elegant red colour, formed from the pellicles or pulp of the seeds of the BIXA, a tree common in South America. It is also called *Terra Orleana*, and *Roucou*.

The manner of making anotta is as follows: The red seeds cleared from the pods, are steeped in water for seven or eight days or longer, till the liquor begins to ferment; then strongly stirred, stamped with wooden paddles and beaters, to promote the separation of the red skins: this process is repeated several times till the seeds are left white. The liquor, passed through close cane-sieves, is pretty thick, of a deep red colour, and a very ill smell; in boiling, it throws up its colouring matter to the surface in form of scum, which is afterwards boiled down by itself to a due consistence, and made up while soft into balls. The anotta commonly met with among us, is moderately hard and dry, of a brown colour on the outside, and a dull red within. It is difficultly acted upon by water, and tinges the liquor only of a pale brownish-yellow colour. In rectified spirit of wine, it very readily dissolves, and communicates a high orange or yellowish red. Hence it is used as an ingredient in varnishes, for giving more or less of an orange-cast to the simple yellows. Alkaline salts render it perfectly soluble in boiling water, without altering its colour. Wool or silk boiled in the solution acquire a deep, but not a very durable, orange-dye. Its colour is not changed by alum or by acids, any more than by alkalis: but when imbibed in cloth, it is discharged by soap, and destroyed by exposure to the air. It is said to be an antidote to the poisonous juice of manioc or cassava.—Labat informs us, that the Indians prepare an anotta greatly superior to that which is brought to us, of a bright shining red colour, almost equal to carmine: that, for this purpose, instead of steeping and fermenting the seeds in water, they rub them with the hands, previously dipt in oil, till the pellicles came off, and are reduced into a clear paste; which is scraped off from the hands with a knife, and laid on a clean leaf in the shade to dry. De Laet, in his notes on Margrave's natural history of Brazil, mentions also two kinds of anotta; one of a permanent crimson colour, used as a fucus or paint for the face; and another which gives a colour inclining

more

more to that of saffron. This last, which is our anotta, he supposes to be a mixture of the first sort with certain resinous matters, and with the juice of the root of the tree. The wax or pulp in which the seeds are inclosed is a cool agreeable rich cordial, and has been long in use among the Indians and Spaniards in America, who still mix it with their chocolate, both to heighten the flavour and raise the colour. It is said to be a successful remedy in bloody-fluxes. The roots have much the same properties with the wax; but these are observed to work more powerfully by the urinary passages: they are used by some people in their broths, and seem to answer all the purposes of the pulp, but in a more faint degree. See Bixa.

ANOUT, a small island in the Schagerrack, or that part of the sea of Denmark which has Norway on the north, Jutland on the west, and the isle of Zealand on the south; it lies in 13° E. Long. and 56° 36′ N. Lat.

ANSÆ, in astronomy, implies the parts of Saturn's ring projecting beyond the disk of the planet.—The word is Latin, and properly signifies *handles*; these parts of the ring appearing like handles to the body of the planet.

ANSARIANS, a people of Syria, so called in the country, but styled in Delisle's maps *Ensarians*, and those of Danville, *Nassaris*. The territory occupied by these Ansaria is that chain of mountains which extends from Antakia to the rivulet called *Nahr-el-Kahir*, or the Great River. The history of their origin, though little known, is yet instructive. The following account is from the *Bibliotheque Orientale* of Assemani, a writer who has drawn his materials from the best authorities.

"In the year of the Greeks 1202 (A. D. 891), there lived at the village of Nasar, in the environs of Koufa, an old man, who, from his fastings, his continual prayers, and his poverty, passed for a saint: several of the common people declaring themselves his partizans, he selected from among them twelve disciples to propagate his doctrine. But the commandant of the place, alarmed at his proceedings, seized the old man, and confined him in prison. In this reverse of fortune, his situation excited the pity of a girl who was slave to the goaler, and she determined to give him his liberty: an opportunity soon offered to effect her design. One day when the goaler was gone to bed intoxicated, and in a profound sleep, she gently took the keys from under his pillow, and after opening the door to the old man, returned them to their place unperceived by her master: the next day when the goaler went to visit his prisoner, he was extremely astonished at finding he had made his escape, and the more so since he could perceive no marks of violence. He therefore judiciously concluded he had been delivered by an angel, and eagerly spread the report, to avoid the reprehension he merited; the old man, on the other hand, asserted the same thing to his disciples, and preached his doctrines with more earnestness than ever. He even wrote a book, in which, among other things, he says, 'I, such a one, of the village of Nasar, have seen Christ who is the word of God, who is Ahmad, son of Mohammad, son of Hanafa, of the race of Ali; who also is Gabriel: and he said to me, Thou art he who readeth (with understanding); thou art the man who speaketh truth; thou art the camel which preserveth the faithful from wrath; thou art the beast which carrieth their burden; thou art the (Holy) Spirit, and John, the son of Zachary. Go, and preach to men that they make four genuflections in praying; two before the rising of the sun, and two before his setting, turning their faces towards Jerusalem: and let them say, three times, God Almighty! God Most High! God Most Great! Let them observe only the second and third festival; let them fast but two days annually; let them not wash the prepuce, nor drink beer, but as much wine as they think proper; and lastly, let them abstain from the flesh of carnivorous animals.' This old man passing into Syria, propagated his opinions among the lower orders of the country people, numbers of whom believed in him: And after a few years he went away, and nobody ever knew what became of him."

Such was the origin of these Ansarians, who are, for the most part, inhabitants of the mountains before mentioned.

The Ansaria are divided into several tribes or sects; among which are distinguished the Shamsia, or adorers of the sun; the Kelbia, or worshippers of the dog; and the Kadmousia, who are said to pay a particular homage to that part in women which corresponds to the priapus.

Many of the Ansaria believe in the metempsychosis; others reject the immortality of the soul; and in general, in that civil and religious anarchy, that ignorance and rudeness which prevail among them, these peasants adopt what opinions they think proper, following the sect they like best, and frequently attaching themselves to none.

Their country is divided into three principal districts farmed by the chiefs called *Mokaddamim*. Their tribute is paid to the Pacha of Tripoli, from whom they annually receive their title. Their mountains are in general not so steep as those of Lebanon, and consequently are better adapted to cultivation; but they are also more exposed to the Turks, and hence doubtless, it happens, that with great plenty of corn, tobacco, wines, and olives, they are more thinly inhabited than those of their neighbours the Maronites and the Druzes.

ANSE, an ancient town of France, in the Lyonois, ten miles north of Lyons, Long. 6. 55. N. Lat. 45. 55.

ANSELM, archbishop of Canterbury, in the reigns of William Rufus and Henry I. He was born in the year 1033, at Aost, a town in Savoy at the foot of the Alps. He became a monk in the abbey of Bec in Normandy; of which he was afterwards chosen prior, and then abbot. In the year 1092, he was invited over to England by Hugh Earl of Chester; and in the year following was prevailed on, as we are told, with great difficulty, to accept the archbishopric of Canterbury. He enjoined celibacy on the clergy; for which he was banished by king Rufus, but recalled by Henry at his coming to the crown. He refused to consecrate such bishops as were invested by the king, according to pope Urban's decree; flatly denying it to be the king's prerogative: for this he was outed again; till, the pope and king agreeing, he was recalled in 1107. In short, from the day of his consecration to that of his death, he was continually employed in fighting the prerogative of the church against that of the crown; and for that purpose spent much of his time in travelling backwards and forwards between England and Rome, for the advice and direction of his Holiness. At the council of Bari, in the kingdom of Naples, the pope being puzzled by the arguments of the Greeks against the Holy Ghost's proceeding from the Father, he called upon Anselm, who was present, and he discussed their objections with great applause. Priests call him a resolute saint; to other people he appears to have been an obstinate and insolent priest. He wrought many miracles, if we believe the author of his life, both before and after his death, which happened at Canterbury, in the 76th year of his age, anno 1109. He was canonised in the reign of Henry VII. Anselm, though we may disregard him as a saint, deserves to be remembered as one of the principal revivers of literature, after three centuries of profound ignorance.

His works have been printed in different years, and at different places, viz. Nuremb. 1491. Paris 1544 and 1549. Venice 1549. Cologn 1573 and 1612. Lyons 1630. But the best is that of father Gerberon, printed at Paris 1675. It is divided into three parts; the first contains dogmatical tracts, and is intitled *Monologia;* the second contains practical and devotional tracts; the third part consists of letters, in four books.

ANSER, in ornithology, the trival name of a species of anas. See Anas.

Anser, in astronomy, a small star, of the fifth or sixth magnitude, in the milky way, between the swan and eagle, first brought into order by Hevelius.

ANSERES, the name which Linnæus gives to his third order of birds. See Zoology, n° 8.

ANSIBARII, or Ansivarii, an ancient people of Germany, situated somewhere in the neighbourhood of the Chauci. All we know of their history is, that in the reign of the Emperor Nero, they were driven from their own pessessions by the Chauci. Being then in a forlorn condition, they took possession of some uninhabited lands, which had been used as pasture for the horses of the Roman soldiers. They were led by one Boiocalus, a man of great valour, and of known fidelity to the Romans. He remonstrated to the Romans, who objected to their taking possession of these lands, That the territory in dispute was large; and requested, that it might be allowed to an unhappy people, driven from their own habitations: that, at the same time, wide tracts might be retained for the horses and cattle of the soldiers to graze in: that it was inconsistent with humanity to famish men in order to feed beasts. &c. and at last, lifting up his eyes to heaven, he asked the celestial luminaries how they could behold a desolate soil, and if they would not more justly let loose the sea to swallow up usurpers, who had engrossed the whole earth? To this the Roman commander, Avitus, replied, that the weakest must submit to the strongest; and that since the gods, to whom they had appealed, had left the sovereign judgment to the Romans, they were resolved to suffer no other judges than themselves. To Boiocalus himself, however, he privately offered lands as a reward for his long attachment to the Romans: but this offer the brave German rejected, as a price for betraying his people; adding, "A place to live in we may want, but a place to die in we cannot." The Ansibarii now invited the neighbouring nations to join them against the Romans; but they, dreading the power of that nation, refused to give them any assistance: upon which they applied to the neighbouring nations, begging leave to settle in their territories; but being every where driven out as enemies and intruders, these unhappy people were reduced to wander up and down till every one of them perished.

ANSIKO, a kingdom of Africa, bounded on the west by the river Umbre which runs into the Zaire, the kingdom of Wangua, and the Amboes who border on Loango; on the north, by some desarts of Nubia; and on the south, by Songo and Sonda, provinces of Congo. Here are great numbers of wild beasts, as lions, rhinoceroses, &c. and many copper mines. The king of Ansiko, or the great Macoco, commands 13 kingdoms, and is esteemed the most powerful monarch in Africa. The inhabitants of Angola have a tradition, that this is the proper country of the Giagas, who came originally from Sierra Leona, and over-ran like a torrent the whole coast as far as Benguela; that, being weakened by numerous battles, and unable to force the defiles in order to return to Sierra Leona, they arrived on the borders of Monomotapa, where being defeated, they were forced to remain in the provinces of Ansiko. Be this as it will, the Ansikans yield not in the least to the Giagas in fierceness and barbarity. They are so accustomed to the eating of human flesh, that it is asserted they have markets where it is publicly sold, and that there are no other graves for the dead than the bellies of the living. They try the courage of their prisoners of war by shooting at them as at marks, directing their arrows above or around their heads; and whoever discovers the least signs of fear, is immediately devoured without remedy. Those who appear intrepid and resolute, have their noses and ears bored, and two fore-teeth of the upper jaw drawn. They are then improved in barbarity, by accustoming them to the most horrid cruelties.

The Ansikans are neat, well-proportioned, and strong; wandering about from place to place, without either sowing or reaping. They are dreaded for their extreme brutality, and never traded with by the Europeans. Their language is barbarious, and difficult to be learned, even by the inhabitants of Congo. The most distinguished among them wear red and black caps of Portuguese velvet: the lower ranks go naked from the waist upwards; and, to preserve their health, anoint their bodies with a composition of pounded white sandal-wood and palm-oil. Their arms are battle-axes, and small but very strong bows adorned with serpents skins. Their strings are made of supple and tender shoots of trees, that will not break, and their arrows of hard and light wood. These people, who kill birds flying, shoot with such surprising swiftness, that they can discharge 28 arrows from the bow before the first falls to the ground. With equal dexterity they manage their battle-axes; one end of which is sharpened and cuts like a wedge, and the other flattened like a mallet, with a handle set between, about half the length of the iron, rounded at the end like an apple, and covered with the skin of a serpent.—The current money in this country is the zimbis or shell, which is fished for, and passes among several African nations.—they worship the sun as their chief deity; whom they represent by the figure of a man, and the moon by that of a woman. They have also an infinite number of inferior deities, each individual having a particular idol whom he addresses on certain occasions.

ANSLO, a sea-port town of Norway, in the province of Aggerhuys, with a bishop's see. The supreme court of justice is held here for Norway. It is seated on a bay of the same name. E. Long. 10. 14. N. Lat. 50. 24.

ANSON (George), a gentleman whose merit and good fortune, as a naval commander, exalted him to the rank of Nobility. He was the son of William Anson, Esq; of Huckborough, in Staffordshire; and showing an early inclination for the sea, received a suitable education. The first command he enjoyed was that of the Weazle sloop in 1722; but the most memorable action of his life, and the foundation of his future good fortune, took place on his receiving the command of five ships, a sloop, and two victuallers, equipped to annoy the Spaniards in the South Seas, and to co-operate with admiral Vernon across the isthmus of Darien: an expedition, the principal object of which failed by the unaccountable delay in fitting him out. He sailed, however, in Sept. 1740; doubled Cape Horn in a dangerous season; lost most of his men by the scurvy; and with one only remaining ship, the Centurion, crossed the great Pacific Ocean. If no considerable national advantage resulted from this voyage, Commodore Anson made his own fortune, and enriched his surviving companions, by the capture of a rich galleon on her passage from Acapulco to Manilla; with which he returned home round the Cape of Good Hope. If he was lucky in meeting this galleon, he was no less fortunate in escaping a French fleet then cruising in the Channel, by sailing through it during a fog. He arrived at Spithead in June 1744. In a short time after his return, he was appointed rear-admiral of the blue, and one of the lords of the admiralty. In April 1745, he was made rear-admiral of the white, and the following year, vice-admiral of the blue; at which time he was chosen to represent the borough of Heydon in parliament. In 1747, being on board the Prince George of 90 guns, in company with Admiral Warren, and 12 other ships, he intercepted off Cape Finisterre, a powerful fleet, bound from France to the East and West Indies; when, by his valour and conduct he again enriched himself and his officers, and at the same time strengthened the British navy, by taking six men of war and four East-Indiamen, not one of them escaping. The French admiral, M. Jonquiere, on presenting his sword to the conqueror, said, *Monsieur, vous avez vaincu l'Invincible, et la Glorie vous suit:* "Sir, you have conquered the Invincible, and Glory follows you; pointing to the ships named the *Invincible* and the *Glory*, he had taken. For his signal services, King George the IId. created him Baron of Soberton in Hants. The same year he was appointed vice-admiral of the red; and, on the death of Sir John Norris, was made vice-admiral of England. In 1748 he was made admiral of the blue: he was afterwards appointed first lord of the admiralty, and was at length made admiral and commander in chief, in which rank he continued, with a very short interval, until his death; and the last service he performed was to convoy Queen Charlotte to England. He died in June 1762. No performance ever met with a more favourable reception, than the account of Anson's voyage round the world. Though it is printed under the name of his chaplain, it was composed under his lordship's own inspection, and from the the materials he himself furnished, by the ingenious Mr Benjamin Robins.

ANSPACH (the marquisate of), a small territory of Franconia, in Germany; bounded on the north by the bishoprics of Wartsburg and Bamberg, which last likewise lies to the west; by the earldoms of Holach and Oeting, with the bishopric of Aichstet, on the south; and the palatinate of Bavaria and the territory of Nuremberg on the east. The country is fruitful, and interspersed with woods, which render it agreeable for hunting. Besides the city Anspach, which is the capital, the chief towns are Kreglin, Swasbach, Kreilsheim, Rot, and Wasser-Truding.

Anspach is a small but pretty town, very well built, and has several churches. It is walled round, but has no other fortifications. In the palace there is a remarkable cabinet of curiosities. It is seated on a river of the same name, and belongs to the house of Brandenburg. E. Long. 10. 42. N. Lat. 49. 14.

ANSPESSADES, in the French armies, a kind of inferior officers in the foot, below the corporals, but above the common centinels. There are usually four or five of them in a company.

ANSTRUTHER *Easter* and *Wester*, two royal boroughs of Scotland, situated on the south-east coast of the county of Fife, in W. Long. 2. 25. N. Lat. 56. 20.

ANT, in zoology. See Formica and Termes.

Ant-Bear, or *Ant-eater*, in zoology. See Myrmecophaga.

Ant-Eggs, a name popularly given to a kind of little white balls found in the banks or nests of ants ordinarily supposed to be the ova of this insect.

Late naturalists have observed, that these are not properly the ants eggs, but the young brood themselves in their first state; they are so many little vermiculi wrapped up in a film, or skin, composed of a sort of silk, which they spin out of themselves as silk-worms and caterpillars do. At first they are hardly observed to stir: but, after a few days continuance they exhibit a feeble motion of flexion and extension; and begin to look yellowish and hairy, shaped like small maggots, in which shape they grow up, till they are almost as large as ants. When they pass their metamorphosis, and appear in their proper shape, they have a small black speck on them close to the anus of the included ant, which M. Liewenhoeck probably enough imagines to be the feces voided by it. Dr Ed. King opened several of these vulgarly reputed eggs; in some of which he found only a maggot in the circumstances as above described; while in another the maggot had begun to put on the shape of an ant about the head, having two little yellow specks, where the eyes were to be. In others, a further progress was observed, the included maggots being furnished with every thing to complete the shape of an ant, but wholly transparent, the eyes only excepted, which were as black as bugles. Lastly, in others, he took out every way perfect and complete ants, which immediately crept about among the rest. These supposed ants eggs are brought up every morning in summer, near the top of the bank, where they are lodged all the warm part of the day, within reach of the ſun's influence. At night, or if it be cool, or like to rain, they carry them down to a greater depth; ſo that you may dig a foot depth e'er you come at them. The true ants eggs are the white ſubſtance which, upon opening their banks, appears to the eye like the ſcatterings of fine white ſugar, or ſalt, but very ſoft and tender. Examined by a microſcope, it is found to conſiſt of ſeveral pure, white appearances, in diſtinct membranes, all figured like the leſſer ſort of birds eggs; and as clear as a fiſhes bladder. The ſame ſubſtance is found in the bodies of the ants themſelves. On this ſpawn, when emitted, they lie in multitudes to brood, till in ſome time it is turned into little vermicles as ſmall as mites, commonly called *ants-eggs*.

Ant-Hills, are little hillocks of earth, which the ants throw up for their habitation and the breeding of their young. They are a very great miſchief to dry paſtures, not only by waſting ſo much land as they cover, but by hindering the ſcythe in mowing the graſs, and yielding a poor hungry food pernicious to cattle. The manner of deſtroying them is to cut them into four parts from the top, and then dig into them ſo deeep as to take out the core below, ſo that, when the turf is laid down again, it may lie ſomewhat lower than the level of the reſt of the land: by this means it will be wetter than the reſt of the land: and this will prevent the ants from returning to the ſame place, which otherwiſe they would certainly do. The earth that is taken out muſt be ſcattered to as great a diſtance every way as may be, otherwiſe they will collect it together and make another hill juſt by. The proper time for doing this is winter; and if the places be left open, the froſt and rains of that time of the year will deſtroy the reſt: but in this caſe care muſt be taken that they are covered up early enough in the ſpring, otherwiſe they will be leſs fertile in graſs than the other places. In Hertfordſhire they uſe a particular kind of ſpade for this purpoſe. It is very ſharp, and formed at the top into the ſhape of a creſcent, ſo that the whole edge makes up more than three-fourths of a circle; this cuts in every part, and does the buſineſs very quickly and effectually. Others uſe the ſame inſtruments that they do for mole-hills. Human dung is a better remedy than all theſe, as is proved by experiment; for it will kill great numbers of them and drive all the reſt away, if only a ſmall quantity of it be put into their hills.

Acid of Ants, and acid produced by diſtilling millions of theſe inſects, either without addition, or with water. It reſembles vinegar in many reſpects; but differs from it in forming cryſtals with magneſia, iron, and zinc. Its attractions are not yet determined, but are ſuppoſed to coincide with thoſe of vinegar.

ANTA, in the ancient architecture, a ſquare pilaſter, placed at the corners of buildings.

Anta, or *Ante*, a ſmall kingdom on the gold-coaſt of Africa, extending about ten leagues in length.—The country is covered with large trees, among which ſtand a number of fine villages. The ſoil is exceedingly rich, and the face of the country beautiful. The air is alſo much more ſalubrious than in other places of the gold-coaſt; it being obſerved by all writers, that the number of deaths here bears no proportion to that on any other part on the coaſts of Guinea. This country contains the following villages, which deſerve a particular deſcription on account of the commerce they drive; viz. *Bourtrey*, *Tokorari*, *Sukoada*, and *Sama*; for which, ſee thoſe articles.—Formerly Anta was potent and populous, inhabited by a bold and rapacious people, who greatly annoyed the Europeans by their frequent incurſions; but by continual wars with their neighbours they are now greatly enfeebled, and the country in a manner depopulated. The ſpirit of the few remaining inhabitants is fled: they are deſponding, diſpirited, and abject, ſeeking protection from the Dutch and other Europeans who have forts on this coaſt, and looking upon them as their beſt friends.

ANTACIDS, in pharmacy, an appellation given to all medicines proper to correct acid or ſour humours.

Under the claſs of antacids come, 1. Abſorbents; as chalk, coral, ſea-ſhells, hæmatites, and ſteel-filings. 2. Obtundents; as oils and fats. 3. Immutants; as lixivious ſalts, and ſoaps.

ANTÆUS, in fabulous hiſtory, a giant of Libya, ſon of Neptune and Terra. Deſigning to build a temple to his father, of men's ſculls, he ſlew all he met; but Hercules fighting him, and perceiving the aſſiſtance he received from his mother (for by a touch of the earth he refreſhed himſelf when weary), lifted him up from the ground, and ſqueezed him to death.

Antæus was king of Mauritania; and from ſeveral circumſtances, with which we are ſupplied by various authors, it appears extremely probable that he was the ſame perſon with Atlas; they were both of them the ſons of Neptune, who reigned over Mauritania, Numidia, and a great part of Libya; as may be naturally inferred from his having ſuch particular marks of diſtinction conferred upon him by the inhabitants of thoſe regions. They both ruled with abſolute power over a great part of Africa, particularly Tingitania. Hercules defeated and ſlew Antæus in the ſame war wherein he took the Libyan world from Atlas: both Atlas and Antæus invaded Egypt, and contended with Hercules in the wars with the gods, and were both vanquiſhed by him. Antæus, as well as Atlas, was famed for his knowledge in the celeſtial ſciences: from whence we may fairly conclude them to have been the ſame king of Mauritania.

Antæus, in his wars with Hercules, who commanded an army of Egyptians and Ethiopians, behaved with great bravery and reſolution. Receiving large reinforcements of Libyan troops, he cut off vaſt numbers of Hercules's men: but that celebrated commander having at laſt intercepted a ſtrong body of Mauritanian or Libyan forces ſent to the relief of Antæus, gave him a total overthrow, wherein both he and the beſt part of his forces were put to the ſword. This deciſive action put Hercules in poſſeſſion of Libya and Mauritania, and conſequently of all the riches in thoſe kingdoms: hence aroſe the fable, that Hercules finding Antæus, a giant of an enormous ſize, with whom he was engaged in ſingle combat, to receive freſh ſtrength as often as he touched his mother earth when thrown upon her, at laſt lifted him up in the air and ſqueezed him to death. Hence likewiſe may be deduced the fable, intimating, that Hercules took Atlas's globe upon his own ſhoulders, overcame the dragon that guarded the orchards of the Heſperides, and made himſelf maſter of all the golden fruit. The golden apples, ſo frequently mentioned by the old mythologiſts, were the treaſures that fell into Hercules's hands

hands upon Antæus's defeat, the Greeks giving the Oriental word מאל, *riches*, the ſignification affixed to their own term, μηλα, *apples*. After the moſt diligent and impartial examination of all the different hypotheſes of hiſtorians and chronologers, relating to Atlas and Antæus, we find none ſo little clogged with difficulties as that of Sir Iſaac Newton. According to that illuſtrious author, Ammon, the father of Seſac, was the firſt king of Libya, or that vaſt tract extending from the borders of Egypt to the Atlantic ocean; the conqueſt of which country was effected by Seſac in his father's life-time. Neptune afterwards excited the Libyans to a rebellion againſt Seſac; ſlew him; and then invaded Egypt under the command of Atlas or Antæus, the ſon of Neptune, Seſac's brother and admiral. Not long after, Hercules, the general of Thebais and Ethiopia for the gods or great men of Egypt, reduced a ſecond time the whole continent of Libya, having overthrown and ſlain Antæus near a town in Thebais, from that event called Antæa or Antæopolis: this, we ſay, is the notion advanced by Sir Iſaac Newton, who endeavours to prove, that the firſt reduction of Libya by Seſac happened a little above a thouſand years before the birth of Chriſt, as the laſt by Hercules did ſome few years after.

ANTAGONIST, denotes an adverſary, eſpecially in ſpeaking of combats and games.

Antagonist muſcles, in anatomy, thoſe which have oppoſite functions; as flexors and extenſors, abductors and adductors, &c.

ANTANACLASIS, in rhetoric, a figure which repeats the ſame word, but in a different ſenſe; as, *dum vivimus, vivamus*.

ANTAGOGE, in rhetoric, a figure by which, when the accuſation of the adverſary is unanſwerable, we load him with the ſame or other crimes.

ANTANDROS, (anc. geog.) a town of Myſia, on the ſea-coaſt, at the foot of mount Alexandrea, a part of mount Ida. (Strabo, Ptolemy): it was a town of the Leleges, (Strabo); anciently called *Edonis*, then *Cimmeris*, (Pliny, Stephanus.) It takes its name from Antandros, a general of the Aeolians: it is now called *S. Dimitri*.

ANTAPHRODISIACS, in pharmacy, medicines proper to diminiſh the ſemen, and conſequently extinguiſh or leſſen all deſires of venery.

ANTARCTIC, in a general ſenſe, denotes ſomething oppoſite to the arctic or northern pole. Hence antarctic circle is one of the leſſer circles of the ſpheres, and diſtant only 23° 30′ from the ſouth pole, which is likewiſe called antarctic for the ſame reaſon.

ANTARES, in aſtronomy, the name of a ſtar of the firſt magnitude, called alſo the ſcorpion's heart. Its longitude is 60° 13′ 14″ of Sagittarius; and its latitude 4° 31′ 26″ S.

ANTAVARE, a province of the iſland of Madagaſcar, lying about 21° 30′ S. Lat. and bounded by the province and cape of Manouſi. The greateſt part of it is watered by the river Mananzari, whoſe ſource is in the red mountains of Ambohitſmene.

ANTE′, in heraldry, denotes that the pieces are let into one another in ſuch form as there is expreſſed; for inſtance, by dove-tails, rounds, ſwallow-tails, or the like.

ANTEAMBULONES, in Roman antiquity, ſervants who went before perſons of diſtinction to clear the way before them. They uſed this formula, *Date locum domino meo*, i. e. Make room or way for my maſter.

ANTECEDENT, in general, ſomething that goes before another, either in order of time or place.

Antecedent, in grammar, the words to which a relative refers.

Antecedent, in logic, is the firſt of the two propoſitions in an enthymeme.

Antecedent, in mathematics, is the firſt of two terms of a ratio, or that which is compared with the other.

ANTECEDENCE, in aſtronomy, an apparent motion of a planet towards the weſt, or contrary to the order of the ſigns.

ANTECESSOR, one that goes before. It was an appellation given to thoſe who excelled in any ſcience. Juſtinian applied it particularly to profeſſors of civil law; and, in the univerſities of France, the teachers of law take the title *anteceſſors* in all their theſes.

ANTECURSORES, in the Roman armies, a party of horſe detached before, partly to get intelligence, proviſions, &c. and partly to chooſe a proper place to encamp in. Theſe were otherwiſe called *anteceſſores*, and by the Greeks *prodromi*.

ANTEDATE, among lawyers, a ſpurious or falſe date prior to the true date of a bond, bill, or the like.

ANTEDILUVIAN, in a general ſenſe, implies ſomething that exiſted before the flood.

Antediluvian-World; the earth as it exiſted before the flood. See Earth.

ANTEDILUVIANS, a general name for all mankind who lived before the flood, and ſo includes the whole of the human race from Adam to Noah and his family.

Chronology of the firſt ages.

As Moſes had not ſet down the particular time of any tranſaction before the flood, except only the years of the fathers age wherein the ſeveral deſcendants of Adam in the line of Seth were begotten, and the length of their ſeveral lives; it has been the buſineſs of chronologers to endeavour to fix the years of the lives and deaths of thoſe patriarchs, and the diſtance of time from the creation to the deluge. In this there could be little difficulty were there no varieties in the ſeveral copies we now have of Moſes's writings; which are, the Hebrew, the Samaritan, and the Greek verſions of the Septuagint: but as theſe differ very conſiderably from one another, learned men are much divided in their opinions concerning the chronology of the firſt ages of the world; ſome preferring one copy and ſome another.

That the reader may the better judge of the variations in the three copies in this period, they are exhibited in the following table, with the addition of thoſe of Joſephus as corrected by Dr Wells and Mr Whiſton.

A TABLE of the Years of the Antediluvian Patriarchs.

	Their ages at their ſons birth.				Years they lived after their ſons birth.			Length of their lives.		
	Heb.	Sam.	Sept.	Joſ.	Heb.	Sam.	Sept.	Heb.	Sam.	Sept.
Adam, -	130	130	230	130	800	800	700	930	930	930
Seth, -	105	105	205	105	807	807	707	912	912	912
Enos, -	90	90	190	90	815	815	715	905	905	905
Cainan, -	70	70	170	70	840	840	740	910	910	910
Mahalaleel, -	65	65	165	65	830	830	730	895	895	895
Jared, -	162	62	162	62	800	785	800	962	847	962
Enoch, -	65	65	165	65	300	300	200	365	365	365
Methuſelah, -	187	67	167	187	782	653	802	969	720	969
Lamech, -	182	53	188	182	595	600	565	777	653	753
Noah was aged at the Flood,	600	600	600	600						
To the Flood,	1656	1307	2262	1556						

To this table it will be neceſſary, in order to explain the conſequences of theſe variations, to add ſeparate chronological tables, ſhowing in what year of his contemporaries the birth and death of each patriarch happened, according to the computation of each of the ſaid three copies.

A Chronological TABLE of the Years of the Patriarchs according to the Computation of the Hebrew.

	Years of the world.	Years of Seth.	Years of Enos.	Years of Cainan.	Years of Mahalaleel.	Years of Jared.	Years of Enoch.	Years of Methuſelah.	Years of Lamech.	Years of Noah.
Adam created,	1									
Seth born, -	130									
Enos born, -	235	105								
Cainan born, -	325	195	90							
Mahalaleel born,	395	265	160	70						
Jared born, -	460	330	225	135	65					
Enoch born, -	622	492	387	297	227	162				
Methuſelah born,	687	557	452	362	292	227	65			
Lamech born, -	874	744	639	549	479	414	252	187		
Adam dies, -	930	800	695	605	535	470	308	243	56	
Enoch tranſlated,	987	857	752	662	592	527	365	300	113	
Seth dies, -	1042	912	807	717	647	582		355	168	
Noah born, -	1056		821	731	661	596		369	182	
Enos dies, -	1140		905	817	745	680		453	266	84
Cainan dies, -	1235			910	840	775		548	361	179
Mahalaleel dies,	1290				895	830		603	416	234
Jared dies, -	1422					962		735	548	366
Japhet born, -	1556							869	682	500
Shem born, -	1558							871	684	502
Lamech dies, -	1651							964	777	595
Methuſelah dies,	1656			The Flood,		-		969		600

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A Chronological TABLE *of the Years of the Patriarchs according to the Computation of the Septuagint.*

	Years of the world.	Years of Seth.	Years of Enos.	Years of Cainan.	Years of Mahalaleel.	Years of Jared.	Years of Enoch.	Years of Methuselah.	Years of Lamech.	Years of Noah.
Adam created,	1									
Seth born, -	230									
Enos born, -	435	205								
Cainan born, -	625	395	190							
Mahalaleel born,	795	565	360	170						
Adam dies, -	930	700	495	305	135					
Jarad born, -	960	730	525	335	165					
Enoch born, -	1122	892	687	497	327	162				
Seth dies, -	1142	912	707	517	347	182				
Methusfelah born,	1387		852	662	492	327	165			
Enos dies, -	1340		905	715	545	380	218			
Lamech born, -	1474			849	679	514	352	187		
Enoch tranflated,	1487			862	692	527	365	200		
Cainan dies, -	1535			910	740	575		248	61	
Noah born, -	1662				867	702		375	188	
Mahalaleel dies,	1690				895	730		403	216	28
Jared dies, -	1922					962		635	448	260
Japhet born, -	2162							875	688	500
Shem born, -	2164							877	690	502
Lamech dies, -	2227							940	753	565
Methufelah dies,	2256							696		595
The Flood, -	2262									600

A Chronological TABLE *of the Years of the Patriarchs, according to the Computation of the Samaritan Pentateuch.*

	Years of the world.	Years of Seth.	Years of Enos.	Years of Cainan.	Years of Mahalaleel.	Years of Jared.	Years of Enoch.	Years of Methufelah.	Years of Lamech.	Years of Noah.
Adam created,	1									
Seth born,	130									
Enos born,	235	105								
Cainan born,	325	195	90							
Mahalaleel born,	395	265	160	70						
Jared born,	460	330	225	135	65					
Enoch born,	522	392	287	197	127	62				
Methufelah born,	587	457	352	262	192	127	65			
Lamech born,	654	524	419	329	259	194	132	67		
Noah born,	707	577	472	382	312	247	185	120	53	
Enoch traflated,	887	757	652	562	497	427	365	300	233	180
Adam dies,	930	800	695	605	535	470		343	276	323
Seth dies,	1042	912	807	717	647	582		462	388	335
Enos dies,	1140		905	815	745	680		553	486	433
Japhet born,	1207			882	812	747		620	553	500
Shem born,	1209			884	814	749		622	555	502
Cainan dies,	1235			910	840	775		648	581	528
Mahalaleel dies,	1290				895	830		703	636	583
Jared, Methufelah, and Lamech, die,	1307		The Flood,			847		720	653	600

To the varieties exhibited in the two laft tables, others might be added, by admitting the various readings of fome numbers in the Samaritan and Septuagint: for as to the Hebrew copies, there is here a conftant agreement among them.

The manufcript from which the Samaritan Pentateuch was publifhed, agrees exactly with the Samaritan numbers given by Eufebius. But St Jerom tells us, that, in his time, there were fome Samaritan copies which make Methufelah 187 years old at the birth of Lamech, and Lamech 182 at the birth of Noah, juft as the Hebrew does. Now if thefe numbers be approved as the true original numbers, the interval from the creation to the flood will be 1556 years; differing from

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from the Hebrew computation but 100 years in the age of Jared at the birth of Enoch: and if this last be allowed to be a mistake of the transcriber, by his dropping a number, and writing 62 instead of 162, as has been suspected, the Samaritan will be perfectly reconciled with the Hebrew, and all difference between them vanish.

Scaliger, on the authority of an old Samaritan chronicle, having at the end a table of the years of the patriarchs to the time of Moses, would correct two of the Samaritan numbers in Eusebius; viz. instead of 65 the age of Mahalaleel when he begat Jared, he thinks it should be 75; and instead of 67, the age of Methuselah when he begat Lamech, he would have it 77. By which alterations he reckons 20 years more to the flood than Eusebius and the manuscript; that is, 1327. But as he acknowledges the table, whereon he grounds these corrections, contains some great absurdities, it seems unreasonable to oppose it to the joint authority of Eusebius and the Samaritan manuscript.

As to the Septuagint, in the common editions of that version, the age of Methuselah at the birth of Lamech is 167; and consequently the sum of this period, according to them, is no more than 2242. But in this case Methuselah will outlive the flood 14 years; and we may well wonder, with Eusebius, where he was preserved. To obviate this objection, we are told, that, in some copies, Methuselah is said to have lived but 782 (not 802) years after the birth of Lamech, and no more than 949 in all. But the Alexandrian manuscrip entirely takes away the the difficulty, by giving the same number in this place with the Hebrew.

Pezron is of opinion, that the age of Lamech at the birth of Noah should be but 182, as it is both in the Hebrew and in Josephus, supposing, with St Austin, that the present number is the error of the scribe who first copied the original Septuagint manuscript in Ptolemy's library. So that he computes 2256 years to the flood. And, if this correction be admitted, and one more mentioned also by St Austin, viz. that Lamech lived 595 years after the birth of Noah, and not 161, as in the present copies, there will then remain no other difference between the Septuagint and the Hebrew than 600 years added to the ages of the six patriarchs when they begat their sons, and Methusaleh will, conformably to the Hebrew and Samaritan, die in the year of the flood.

Having premised this chronological view, we shall proceed to the history of the antediluvian patriarchs.

2 Of Adam in Paradise.

Of the great progenitor we are told, that "the Lord God took the man and put him into the garden." These words plainly indicate, that Adam was not created within the precincts of Paradise; and it is afterwards said, upon his being turned out of the garden, "He was sent to till the ground whence he was taken."—As to the situation of this garden, concerning which there has been so much learned but uncertain enquiry, see the article PARADISE.

Adam was doubtless created in the prime of his life, with all his powers and faculties in the highest degree of strength and vigour. His body would be graceful, and well proportioned; while his countenance was comely, and glowed with all the lustre of youthful innocence. The poet thus describes our first parents:

Adam the goodliest man, of men since born
His sons; the fairest of her daughters Eve.
——— for in their looks divine
The image of their glorious Maker shone. *Milton.*

Many have entertained an opinion (as mentioned under the article ADAM), that our first parent was created an adept in knowledge and in science, a consummate philosopher, and an accomplished divine. But the very reverse of this must be true, providing we give credit to the account which Moses gives of him. If Adam was created with intuitive knowledge, for what end was he endowed with the senses of a man, through which ideas might be conveyed to his mind, and make him capable of such improvements as arise from experience and observation? And if he originally possessed such a fund of valuable knowledge, why had he such an ardent thirst for an unwarrantable portion of more, and for the sake of this additional pittance forfeited his happiness and life? Besides, if Adam was at first all light and knowledge, and was soon after reduced to a state of ignorance and error, this transition would make a retrograde in the system of nature, quite dissimilar to that uniformity which obtains throughout the whole of the divine government and œconomy. Moses introduces our first parents into life in the most natural manner, as having capacities to acquire knowledge, senses to receive impressions from objects around them, and a sufficient degree of reason to form a judgment of the things perceived: yet all these faculties can only be considered as so many instruments, by the exercise of which they might be enabled to discharge the duties of their future life.

Smellie's Translation, vol. iii. p. 50. *&c.* (the passage here abridged).

The following portrait of our first progenitor when he first came into life, drawn by the inimitable pencil of Buffon, is extremely beautiful, while it is dissonant from no part of the Mosaic history. "Let us suppose a man in the same situation with him who first received existence; a man whose organs were perfectly formed, but who was equally new to himself, and to every object which surrounded him. Were he to give a history of his thoughts, and of the manner in which he received impressions, he might give some such information at this. I remember the moment when my existence commenced. It was a moment replete with joy, with amazement and anxiety. I neither knew what I was, where I was, nor whence I came. I opened my eyes. But what an amazing increase of sensation! The light, the celestial vault, the verdure of the earth, the transparency of the waters, gave animation to my spirits, and conveyed pleasures which exceed the powers of expression. At first I believed that all these objects existed within me, and formed a part of myself. When, turning mine eyes to the sun, his splendor overpowered me. I voluntarily shut out the light, and felt a small degree of pain. During this moment of darkness, I imagined that I had lost the greatest part of my being. I was then roused with a variety of sounds. The singing of birds and the murmuring breezes formed a concert, which excited the most sweet and enchanting emotions. I listened, and was convinced that these harmonious sounds existed within me.—I made a step forwards; and afterwards renewing my motion, I walked with my face turned towards

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towards the Heavens, till I ſtruck againſt a palm tree, and felt ſome degree of pain. Seized with terror, I ventured to lay my hand upon the object, and perceived it to be a being deſtinct from myſelf, becauſe it did not, like touching my own body, give me a double ſenſation. I reſolved then to feel every object I ſaw, and had a ſtrong deſire to touch the ſun; but ſtretching out my hands to embrace the Heavens, they met without any intermediate object. All objects appeared to me equally near, and it was not till after many trials that I learned to uſe my eyes as a guide to my hand. At laſt the train of my ideas was interrupted, and I loſt the conſciouſneſs of my exiſtence. My ſleep was profound; but having no mode of meaſuring time, I knew nothing of its duration. When I awakened, I was aſtoniſhed to find by my ſide another form, perfectly ſimilar to my own. I conceived it to be another ſelf; and inſtead of loſing by my ſleep, I imagined myſelf to be doubled. I ventured to lay my hand upon this new being. With rapture and aſtoniſhment, I perceived that it was not myſelf, but ſomething much more glorious and deſirable."

This philoſophical detail coincides with the opinion, that excepting what portions of knowledge Adam might acquire by the exerciſe of his ſenſes, his Maker taught him every thing that was neceſſary for his comfort and ſubſiſtence. But before the Almighty gave any inſtructions to our firſt parents, we muſt ſuppoſe he inſpired them with the knowledge of the meaning of every word which they heard him ſpeak; otherwiſe it would have been impoſſible that he could have had any ſuch communication with them. The words which they heard, and were made to underſtand, being imprinted upon their memories, would ſerve as the foundation of a language, which they would afterwards increaſe and enlarge as new objects began to multiply, and hence give riſe to new terms and definitions.

One of the firſt leſſons taught to Adam by his infallible Director, would be the neceſſity of food for the ſupport of his life. Accordingly Moſes informs us, that for this purpoſe a grant was made him to eat of every tree of the garden excepting one. At the ſame time it was made known to him, in what manner he was to repair the decays of nature; namely, by eating of *the tree of life*. Then, in order to qualify him for ſocial intercourſe, he was ordered to exerciſe his faculty of ſpeech, by giving names to different creatures. The author of the book of Eccleſiaſticus ſays of our firſt parents, "They received the uſe of the five operations of the Lord; and in the ſixth, he imparted to them underſtanding; and in the ſeventh, ſpeech to interprete the cogitations thereof." The meaning cannot be, that he gave them every word they were to pronounce, more than every idea which their ſenſes were to convey to their underſtanding. Our talents, and the exerciſe of them, may be both ſaid to be given us of God; but whatever capacities we receive from him, it is ſuppoſed that we ourſelves muſt improve them, before we can attain to any acquirements whatever. Although Adam had heard and underſtood the words of God, yet Moſes does not give the leaſt hint that he ever attempted to ſpeak before this time. For if he had, as ſome imagine, innate knowledge and proper terms for every thing preſented to him, what occaſion was there to bring animals before him to ſee what names he would impoſe upon them? Some writers have endeavoured to turn into ridicule the whole of this tranſaction, and have aſked, how could all creatures upon earth appear at one time before Adam? not only one, but many days would have elapſed before he could give each a name. But this objection ariſes from not underſtanding the words of Moſes. What our tranſlators render to ſee what he would call THEM, is in the original to ſee what name he would call IT. "And whatſoever Adam called IT (viz. the living creature), that was the name of IT." The meaning ſeems to be no more than this: God brought a few creatures to Adam, to make him try to name them; and whatever he called any of them, that continued to be its name. And no doubt he would denominate every animal before him, from its external appearances, from its ſize, its colour, or its voice: And in proceſs of time, he would give names to all thoſe creatures which providence brought within his view, or with which he became afterwards acquainted.

The next thing in which God inſtructed Adam, tho' probably in a trance or viſion, was his near relation to Eve, as being part of his own body. This piece of knowledge was imparted to him, in order to cement the greater love and affection between the two during the remaining period of their lives.

Theſe, according to Moſes, are all the tranſactions in which our firſt parents were intereſted during their abode in Paradiſe, till they loſt their innocence, and forfeited the enjoyments of their happy ſituation. And nothing can be more evident, than that the inſtructions which they received, beſpoke the infantile ſtate of their minds; tho' there is no doubt but further and higher diſpenſations of knowledge would have been communicated to them, as they became able to bear them, and had their minds matured by experience and reflection.

3

How long our firſt parents retained their innocence.

How long our firſt parents retained their innocence, we are no where told. Many aſſert that they fell on the very firſt day of their creation. But Moſes mentions ſo many tranſactions on that day, as muſt have ingroſſed the whole of their attention, and prevented them from falling into ſuch temptations as ariſe from indolence and want of reflection. Beſides, if in ſuch circumſtances as they were placed, they could not refrain from an open violation of the Divine law for the ſpace of one day, it would beſpeak a deceitfulneſs of heart in them greater than in moſt of their poſterity. It is ſomewhat ſingular, that many of the great trials recorded in ſacred writing were limited to 40 days; which in prophetic ſtyle is ſometimes equivalent to 40 years. This appears from the hiſtory of Moſes, of Elijah, of Nineveh, and of the Jewiſh nation after the death of Chriſt. And what is very remarkable, he, of whom Adam was a type, was tempted 40 days in the wilderneſs. Agreeable to this part of the Divine œconomy, perhaps the trial of our firſt parents laſted ſo long. However, that they remained for a conſiderable time in the garden, appears highly probable from this conſideration, that their indulgent Creator, who had manifeſted his tender concern for them while innocent, and extended his mercy to them when fallen, would never have turned them out of paradiſe, and ſent

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sent them into an uncultivated world, before they had acquired the arts of living, and were capable of providing against the vicissitudes of their future lot. The particulars of this memorable transaction are considered under the article FALL.

Moses gives us no further account of Adam's life after leaving the garden, but that he begat some children, and died at such an age. Yet we have no reason to doubt, but the venerable patriarch ever after led a life of penitence and of the strictest piety. The various communications which he had enjoyed with his Maker in paradise, and which were probably renewed to him after his fall, could not fail to make the deepest impressions upon his mind. The gracious respite he had met with, from the execution of the sentence denounced against him, would make him cautious of offending for the time to come; lest the next violation of the Divine authority should put an end to his existence. The *cherubim and flaming sword*, or the devouring flame, on the *east of Eden* (which might continue burning all his life), would be to him what the vestiges of the ark were to Noah and his sons, an awful memorial of the danger of incurring the Divine displeasure. Besides, his worldly comforts being in a great measure withdrawn, his mind would be naturally disposed for relishing those pleasures which flow from piety and religion.

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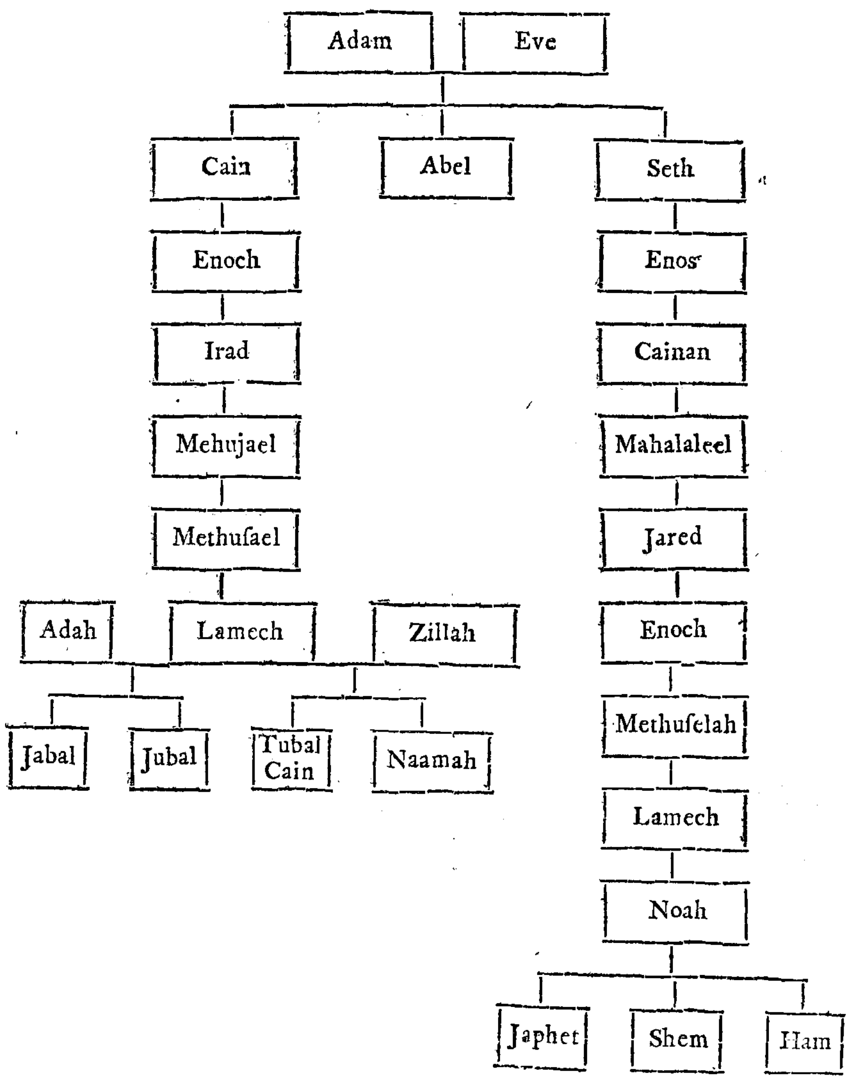
4 Of their progeny.

The first thing which we hear of Adam in his new situation was, that *he knew Eve his wife, and she conceived and bare Cain.* Afterwards, we are told, she bare Abel. When the brothers were grown up, they betook themselves to distinct employments; the former to husbandry, and the latter to the keeping of sheep. Their inward dispositions were still more different; Cain being wicked and avaricious, but Abel just and virtuous.

In process of time they brought their respective offerings to God. Cain of the fruit of the ground, and Abel of the firstlings of his flock; but they met with very different success: for God accepted the offering of Abel, but Cain's he did not accept; the consequences of which are related under the articles ABEL and CAIN.

Soon after the murder of Abel, his loss was made up to his parents in another son they had, whom Eve named *Seth*, that is, "appointed;" because he was appointed instead of Abel, whom Cain slew.

As the whole progeny of Adam, of whom we have any mention in Scripture, were the descendants of Cain and Seth, it may be proper to give the following genealogical table of the Antediluvians.



The

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5 Of the line of Cain.

The sacred historian, confining himself chiefly to the line of Seth, from whence Noah was descended, has acquainted us with very few particulars relating to that of Cain: nor can we thus form any conjectures how long he or any of his descendents lived. All we know is, that Lamech, the fifth in descent from him, married two wives, Adah and Zillah, the first known instance of polygamy: that by the former he had two sons, Jabal, who was the first that dwelt in tents, and fed cattle; and Jubal, the inventor of music; and by the other, a son named Tubal-Cain, who found out the art of forging and working metals. Zillah likewise brought him a daughter named Naamah, supposed to have invented spinning and weaving: and we are told that, on some occasion or other, Lamech made a speech to his wives, the explication of which has greatly puzzled the interpreters. See LAMECH.

6 The line of Seth.

Miln's Physico-theolog. Lectures, p. 242, &c.

Moses proceeds to tell us, that Seth had a son born to him called *Enos*, and that *then began men to call upon the name of the Lord*. Commentators give us three different senses of these words. Some think the words should be rendered, *Then men profaned in calling on the name of the Lord;* and that even Enos arrogated to himself a power, as if he had been a god. But this sense seems harsh and unnatural. There is nothing more unlikely, than that Adam's grandchildren, who lived under his own eye, would so soon shake off parental authority, and apostatise from the belief and worship of the one true God. Others think, that though men had hitherto worshipped God in private, yet they now instituted public assemblies, met in larger societies for solemn and social worship, and introduced liturgies and forms for more effectually paying their homage to the Almighty. This indeed is a very natural comment from those who place religion in modes and set forms of worship. But it is scarcely credible, that Adam and his family had never met together to worship God till now, when we are told that Cain and Abel, and probably both their families along with them, brought their offerings to the Lord: this they no doubt did every sabbath-day. Others, therefore, put a more consistent interpretation upon the words, namely, that *men now called themselves by the name of the Lord*. The meaning of which is, that about this period, the family of Seth, who adhered to God and his worship, began to give themselves a denomination, expressive of their relation and regards to him. They distinguished themselves from the irreligious family of Cain, and assumed the title of the *sons* or *children* of God; which designation was afterwards applied to them by Moses; it was even used after the flood, and adopted by the writers of the New Testament.

Of the three next descendents of Seth, Cainan, Mahalaleel, and Jared, and of Methuselah and Lamech, the grandfather and father of Noah, Moses has recorded no more than their several ages. The oriental authors commend them, as they do Seth and Enos, for their piety, and the salutary injunctions they left behind them, forbidding their children all intercourse with the race of cursed Cain.

Enoch, the son of Jared and father of Methuselah, was a person of most extraordinary piety, *walking with God*, as the Scripture expresses it, for at least the last three hundred years of his life: as a reward for which exemplary behaviour in so corrupt an age, he was taken up by God into heaven, without tasting death. See ENOCH.

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7 Corruption of the human race.

Moses afterwards informs us, *When men began to multiply*, i. e. when the earth was filled with inhabitants, and tribes formerly living remote, began to approach nearer to one another, *Daughters were born unto them;* meaning, in greater abundance than formerly: which seems to hint, that at this period there were considerably more females than males born into the world. Some think that Moses, being now about to mention the wickedness of the Antediluvians, introduces the posterity of Cain as being the chief cause of their corruption; and that he styles them *men* and *daughters of men*, because they were sensual and earthly; in which sense the word *men* is sometimes used in the scriptures.

The sons of God saw the daughters of men that they were fair; and they took them wives of all that they chose. These words have given rise to many absurd and ridiculous comments both of Jews and Christians. There are two meanings affixed to them, which may be mentioned as the most probable. Whenever the name of God is added to any thing, it not only denotes God's being the efficient cause, but it heightens and increases its usual meaning. For which reason any thing that is excellent in its kind, or uncommonly lofty and magnificent, was by the Jews said to be of God, or of the Lord. Thus the angels are called the *sons of God*. And Adam being created with a nobler image than any other creature, is said to be made in the *image of God*. The cedars of Lebanon are called the *cedars of the Lord;* and great mountains, the *mountains of God*. Therefore by the *sons of God* in this place are meant men of great opulence, power, and authority. And by way of contrast, the historian introduces those of poor and mean circumstances in life, and calls them the *daughters of men*. The words thus explained are not an unlikely description of that dissolute age. The great and mighty in this world are commonly most addicted to sensual gratifications, because they have so many incentives to inflame their passions, and so few restraints to curb them; and, instead of using their power to punish and discountenance vice, are too often the greatest examples and promoters of lasciviousness and debauchery. Thus, these *sons of God*, these great men, when they happened to meet with the daughters of their inferiors, gazed upon them as fit objects to gratify their lust; and from among these they *took to themselves*, in a forcible manner *wives*, or (as it may be rendered) *concubines*, *of all that they chose*, whether married or unmarried, without ever asking their consent. No wonder then that the earth should be *filled with violence*, when the highest rank of men were above the restraint of law, of reason and religion, and not only oppressed the poor, but with impunity treated them and their children in such a base and cruel manner.

But there are other writers who cannot relish the above opinion; because they think it a harsh and unnatural construction, to call great and powerful persons the *sons of God*, and all mean and plebeian women the *daughters of men*. Besides, the text does not say, that the *sons of God* offered any violence to these inferior women;

Antediluvians. women; but that they saw that they were *fair*, and made choice of them for wives. And wherein is the heinousness of the offence, if men of a superior rank marry their inferiors, especially when an excess of beauty apologises for their choice? Or why should a few unequal matches be reckoned among the causes of bringing upon the world an universal destruction? For these reasons many are of opinion, that the descendants of Seth, who were styled the *sons of God* on account of their near relation to him, saw the *daughters of men*, i. e. the impious progeny of Cain, and by intermarriages became associated with them; and surrendering to those inchantresses their hearts and their freedom, they surrendered at the same time their virtue and their religion. From this union proceeded effects similar to what has happened ever since. When a pure society mixes with a profane, the better principles of the one become soon tainted by the evil practices of the other; which verifies the old adage, *Evil communication corrupts good manners.* Thus it appears, that the great source of universal degeneracy, was owing to the posterity of Seth mingling with the progeny of Cain, in opposition to what their pious fathers had strictly charged them.

Miln. p. 265.

It is afterwards said, *There were giants in the earth in those days: and also after that, when the sons of God came in unto the daughters of men, and they bare children to them, the same became mighty men, which were of old, men of renown.* Translators are not agreed about the meaning of the word *giants*. Some render the word, *violent and cruel men;* others, men who *fall upon* and *rush forward*, as a robber does upon his prey: the meaning then is, that they were not more remarkable for their strength and stature than for their violence and cruelty. It is generally agreed, that in the first ages of the world, men were of a gigantic stature; though Moses does not mention them as giants till after the union of the families of Seth and Cain, when men used their superiority in bodily strength for the purposes of gratifying their unhallowed passions.

At this period of the world, and long after, political power and bodily strength went hand in hand together. Whoever was able to encounter and kill a fierce and dangerous wild beast and clear the country of noxious animals, or who was able in the day of battle to destroy most of his enemies, was looked up to by the rest of his companions as the fittest to be their leader and commander. Thus, Nimrod, from being a *mighty hunter*, became a great king, and grasping at power, was never satisfied till every obstacle to his ambition was removed. And it appears from history, that all his successors have pretty nearly trodden in the same path. These *giants* then, or *sons of God*, might be the chief warriors, who formed themselves into chosen bands, and living among a cowardly and effeminate people had no curb to their cruelty and lust. From them might spring an illegitimate race, resembling their fathers in body and mind, who, when they grew up, having no inheritance, would be turned loose upon the world, and follow no other employment but theft, rapine, and plunder. Thus they became *mighty men* and *men of renown, and procured themselves a name:* but this was owing to the mischief they did, and the feats of savage cruelty which they performed.

8 God's forbearance.

Mankind running thus headlong into all manner of vice, were admonished to repent; and God, out of his great mercy was pleased to grant them a convenient time for that purpose; no less than 120 years, during which space, but no longer, he declared his Spirit should "strive with man," or endeavour to awaken and reclaim them from their wicked course of life.

Amidst this general corruption, one man, however, was found to be just and perfect in his generation, walking with God. This extraordinary person was Noah, the son of Lamech; who, not thinking it sufficient to be righteous himself unless he did his utmost to turn others likewise to righteousness by admonition as well as example, became a preacher to the abandoned race among which he lived, employing both his counsel and authority to bring them to a reformation of their manners, and to restore the true religion among them. But all he could do was to no purpose; for they continued incorrigibly obstinate: so that at length (as Josephus tells us), finding himself and family in imminent danger of some violence in return for his good-will, he departed from among them, with his wife and children.

9 Preaching of Noah.

10 Mankind incorrigible.

On his departure, it is probable they fell into greater disorders than before; having now none to control or even to trouble them with unwelcome advice. Moses assures us, "that the wickedness of man was great in the earth, and that every imagination of the thoughts of his heart was continually evil;" and that "the earth was corrupt and filled with violence, all flesh having corrupted his way upon the earth." These words leave no room to inquire into the particular crimes of the antediluvian world, which seems to have been over-run with a complication of all manner of debauchery and wickedness, and above all with violence and injustice towards one another.

11 The whole world destroyed by a flood, except Noah and his family.

Things being in this state, God, as the sacred historian pathetically expresses it, "repented that he had made man on earth, and it grieved him at his heart." And the time of forbearance being elapsed, he passed the sentence of their utter destruction by a flood of waters; a sentence which likewise included the beasts of the earth and every creeping thing, and the fowls of the air. But "Noah found grace in the eyes of the Lord;" who had before acquainted him with his design of bringing a deluge on the earth, and directed him to make an ark, or vessel, of a certain form and size, capable of containing not only himself and family, but such numbers of animals of all sorts as would be sufficient to preserve the several species and again replenish the earth, together with all necessary provisions for them. All these injunctions Noah performed; and, by God's peculiar favour and providence, he and those that were with him survived this tremendous calamity. See the article DELUGE.

12 Traditional history of the Antediluvians

As to any further transactions before the flood, we are left entirely in the dark by the sacred historian. The Jews and eastern nations, however, have made ample amends for the silence of Moses, by the abundance of their traditions. The only part of these, which can be connected in any thing like history, is what follows.———After the death of Adam, Seth with his family separated themselves from the profligate race of Cain, and chose for their habitation the mountain where Adam was buried, the Cainites remaining below in the plain where Abel was killed; and, according to our historians, this mountain was so high,

that

Antediluvians. that the inhabitants could hear the angels singing the praises of God, and even join them in that service. Here they lived in great purity and sanctity of manners. Their constant employment was praising God, from which they had few or no avocations; for their only food was the fruits of the trees which grew on the mountain, so that they had no occasion to undergo any servile labours, nor the trouble of sowing and gathering their harvest. They were utter strangers to envy, injustice, or deceit. Their only oath was, "By the blood of Abel; and they every day went up to the top of the mountain to worship God, and to visit the body of Adam, as a mean of procuring the Divine blessing. Here, by contemplation of the heavenly bodies, they laid the foundations of the science of astronomy; and lest their inventions should be forgotten, or lost before they were publicly known, understanding, from a prediction of Adams, that there would be a general destruction of all things, once by fire, and once by water, they built two pillars, one of brick, and the other of stone, that if the brick one happened to be overthrown by the flood or otherwise destroyed, that of stone might remain. This last, Josephus says, was to be seen in his time in the land of Siriad, (thought to be in Upper Egypt).

The descendants of Seth continued in the practice of virtue till the 40th year of Jared, when an hundred of them hearing the noise of the music and the riotous mirth of the Cainites, agreed to go down to them from the holy mountain. On their arrival in the plain, they were immediately captivated by the beauty of the women; who were naked, and with whom they defiled themselves; and this is what is meant by the intermarriage of the sons of God with the daughters of men, mentioned by Moses. The example of these apostate sons of Seth was soon followed by others; and from time to time great numbers continued to descend from the mountain, who, in like manner, took wives from the abandoned race of Cain. From these marriages sprung the giants (who, however, according to Moses existed before); and, these being as remarkable for their impiety as for their strength of body, tyrannized in a cruel manner, and polluted the earth with wickedness of every kind. This defection became at last so universal, that none were left in the holy mountain, except Noah, his wife, his three sons and their wives.

13 Profane history. *Berosus's Babylonian Antiquities.* Berosus, a Chaldæan historian, who flourished in the time of Alexander the Great, enumerates ten kings who reigned in Chaldea before the flood; of whom the first, called *Alorus*, is supposed to be Adam, and Xisuthrus, the last, to be Noah.—This Alorus, declared that he held his kingdom by divine right, and that God himself had appointed him to be the pastor of the people. According to our historian, in the first year of the world, there appeared out of the Red Sea, at a place near the confines of Babylonia, a certain *irrational* animal called *Oannes*. He had his whole body like that of a fish; but beneath his fish's head grew another of a different sort, (probably a human one). He had also feet like a man, which proceeded from his fish's tail, and a human voice, the picture of him being preserved ever after. This animal conversed with mankind in the day-time, without eating any thing: he delivered to them the knowledge of letters, sciences, and various arts: he taught them to dwell together in cities, to erect temples, to introduce laws, and instructed them in geometry; he likewise showed them how to gather seeds and fruits, and imparted to them whatever was necessary for a convenient and civilized life; but after this time there was nothing excellent invented. When the sun set, Oannes retired into the sea, and continued there all night. He not only delivered his instructions by word of mouth, but, as our author assures us, wrote of the origin of things, and of political œconomy. This, or a similar animal, is also mentioned by other authors.

Of Alasporus, the second king, nothing remarkable is related. His successor, Amelon, or Amillarus, was of a city called *Pantabibla*. In his time another animal resembling the former appeared 260 years after the beginning of this monarchy. Amelon was succeeded by Metalarus; and he by Doanus, all of whom were of the same city. In the time of the latter, four animals of a double form, half man and half fish, made their appearance. Their names were *Euedocus, Eneugamus, Encubulus*, and *Anementus*. Under the next prince, who was likewise of Pantabibla, appeared another animal of the same kind, whose name was *Odacon*. All these explained more particularly what had been concisely delivered by Oannes.

In the reign of the tenth king, Xisuthrus, happened the great deluge, of which our author gives the following account: Cronus, or Saturn, appeared to Xisuthrus in a dream, and warned him, that on the fifteenth of the month Dæsius mankind would be destroyed by a flood; and therefore commanded him to write down the original, intermediate state, and end of all things, and bury the writings under ground in Sippara, the city of the sun; that he should also build a ship, and go into it with his relations and dearest friends, having first furnished it with provisions, and taken into it fowls and four-footed beasts; and that, when he had provided every thing, and was asked whither he was sailing, he should answer, *To the gods, to pray for happiness to mankind.* Xisuthrus did not disobey; but built a vessel, whose length was five furlongs, and breadth two furlongs. He put on board all he was directed; and went into it with his wife, children, and friends. The flood being come, and soon ceasing, Xisuthrus let out certain birds, which finding no food, nor place to rest upon, returned again to the ship. Xisuthrus, after some days, let out the birds again; but they returned to the ship, having their feet daubed with mud: but when they were let go the third time, they came no more to the ship, whereby Xisuthrus understood that the earth appeared again; and thereupon he made an opening between the planks of the ship, and seeing that it rested on a certain mountain, he came out with his wife, and his daughter, and his pilot; and having worshipped the earth, and raised an altar, and sacrificed to the gods, he and those who went out with him disappeared. They who were left behind in the ship, finding that Xisuthrus and the persons that accompanied him did not return, went out themselves to seek for him, calling him aloud by his name; but Xisuthrus was no more seen by them: only a voice came out of the air, which enjoined them, as their duty was, to be religious; and informed them, that on account of his own piety he was gone to dwell with the gods, and that

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that his wife and daughter and pilot, were partakers of the ſame honour. It alſo directed them to return to Babylon, and that, as the fates had ordained, they ſhould take the writings from Sippara, and communicate them to mankind; and told them, that the place where they were was the country of Armenia. When they had heard this, they offered ſacrifice to the gods, and unanimouſly went to Babylon; and when they came thither, they dug up the writings at Sippara, built many cities raiſed temples, and rebuilt Babylon.

14 Antediluvian kings of Egypt.

The Egyptians who would give place to no nation in point of antiquity, have alſo a ſeries of kings, who, as is pretended, reigned in Egypt before the flood; and to be even with the Chaldeans, began their account the very ſame year that theirs does according to Beroſus.

There was an ancient chronicle extant among the Egyptians, not many centuries ago, which contained 30 dynaſties of princes who ruled in that country, by a ſeries of 113 generations, through an immenſe ſpace of 36,525 years, during which Egypt was ſucceſſively governed by three different races; of whom the firſt were the Auritæ, the ſecond the Meſtræi, and the third the Egyptians.

But this extravagant number of years Manetho (to whoſe remains we muſt chiefly have recourſe for the ancient Egyptian hiſtory) has not adopted, however, in other reſpects he is ſuppoſed to have been led into errors in chronology by this old chronicle, which yet ſeems to have been a compoſition ſince Manetho's time.

15 Sanchoniatho's Phœnician hiſtory.

The account given by Beroſus is manifeſtly taken from the writings of Moſes; but we have another account of the firſt ages of mankind, in which no mention is made of the flood at all. This is contained in ſome fragments of a Phœnician author called *Sanchoniatho*, who is by ſome ſaid to have been cotemporary with Gideon, by others to have lived in the days of king David; while ſome boldly aſſert there never was ſuch a perſon, and that the whole is a fiction of Philo-Biblius, in oppoſition to the books of Joſephus written againſt Apion. To gratify the reader's curioſity, however, we have ſubjoined an account of the firſt ten generations mentioned by him, which are ſuppoſed by the compilers of the Univerſal Hiſtory to correſpond to the generations mentioned by Moſes before the flood.

Sanchoniatho having delivered his coſmogony, or generation of the other parts of the world, begins his hiſtory of mankind with the production of the firſt pair of mortals, whom Philo, his tranſlator, calls *Protogonus* and *Æon;* the latter of whom found out the food which was gathered from trees.

Their iſſue were called *Genus* and *Genea*, and dwelt in Phœnicia: but when the great droughts came, they ſtretched forth their hands to heaven towards the ſun; for him they thought the only God and Lord of heaven, calling him *Beelſamen*, which in Phœnician is *Lord of heaven*, and in Greek *Zeus.*

Afterwards from Genus, the ſon of Protogonus and Æon, other mortal iſſue was begotten, whoſe names were *Phos, Pur, and Phlox;* that is, *Light, Fire,* and *Flame.* Theſe found out the way of generating fire, by the rubbing of pieces of wood againſt each other, and taught men the uſe thereof. They begat ſons of vaſt bulk and height, whoſe names were given to the mountains on which they ſeized: ſo from them were named mount *Caſſius Libanus, Antilibanus*, and *Brathys.*

Of theſe laſt were begotten Memrumus, and Hypſuranius; but they were ſo named by their mothers, the women of thoſe times, who without ſhame lay with any man they could light upon. Hypſuranius inhabited Tyre, and he invented the making of huts of reeds and ruſhes, and the papyrus. He alſo fell into enmity with his brother Uſous, who firſt invented a covering for his body out of the ſkins of the wild beaſts which he could catch. And when violent tempeſts of winds and rains came, the boughs in Tyre being rubbed againſt each other, took fire, and burnt the wood there. And Uſous, having taken a tree, and broke off its boughs, was ſo bold as to venture upon it into the ſea. He alſo conſecrated two rude ſtones, or pillars, to fire and wind; and he worſhipped them, and poured out to them the blood of ſuch wild beaſts as had been caught in hunting. But when theſe were dead, thoſe that remained conſecrated to them ſtumps of wood and pillars, worſhipping them, and kept anniverſary feaſts unto them.

Many years after this generation came Agreus and Halicus, the inventors of the arts of hunting and fiſhing, from whom huntſmen and fiſhermen are named.

Of theſe were begotten two brothers, the inventors of iron and of the forging thereof: one of theſe, called *Chryſor*, the ſame with Hepheſtus or Vulcan, exerciſed himſelf in words and charms and divinations; found out the hook, bait, and fiſhing-line, and boats ſlightly built; and was the firſt of all men that ſailed. Wherefore he alſo was worſhipped after his death for a god; and they called him *Zeus Michius*, or Jupiter the engineer; and ſome ſay his brothers invented the way of making walls of brick.

Afterwards from this generation came two brothers; one of whom was called *Technites*, or the Artiſt; the other, *Geinus, Autochthon*, [the home-born man of the earth.] Theſe found out to mingle ſtubble, or ſmall twigs, with the brick earth, and to dry them in the ſun, and ſo made tyling.

By theſe were begotten others; of which one was called *Agrus* [Field]; and the other *Agrouerus*, or *Agrotes*, [Huſbandmen], who had a ſtatue much worſhipped, and a temple carried about by one or more yoke of oxen, in Phœnicia, and among thoſe of Byblus he is eminently called the *greateſt of the gods.* Theſe found out how to make courts about mens houſes, and fences and caves, or cellars. Huſbandmen, and ſuch as uſe dogs in hunting, derive from theſe; and they are alſo called *Aletæ* and *Titans.*

Of theſe were begotten Amynus and Magus, who ſhowed men to conſtitute villages and flocks.

In theſe mens age there was one Eliun, which imports in Greek *Hypſiſtus* [the moſt high], and his wife was named *Beruth*, who dwelt about Byblus: and by him was begot one Epigerus, or Autochton, whom they afterwards called *Uranus* [heaven]; ſo that from him that element which is over us, by reaſon of its excellent beauty, is called *heaven:* and he had a ſiſter of the ſame parents called *Ge*, [the earth]; and by reaſon of her beauty, the earth had her name given to it.

Hypſiſtus, the father of theſe, dying in fight with wild beaſts, was conſecrated, and his children offered ſacrifices and libations to him.—But Uranus taking the kingdom

Antediluvians. kingdom of his father, married his sister Ge, and had by her four sons; Ilus, who is called *Cronus* [or Saturn]; Betylus; Dagon, who is Siton or the god of corn; and Atlas: but by other wives Uranus had much issue.

As to the customs, policy, and other general circumstances of the Antediluvians, we can only form conjectures.

The only thing we know as to their religious rites is, that they offered sacrifices, and that very early, both of the fruits of the earth, and of animals; but whether the blood and flesh of the animals, or only their milk and wool, were offered, is a disputed point.—

16 Arts, &c. of the Antediluvians.

Of their arts and sciences, we have not much more to say. The antediluvians seem to have spent their time rather in luxury and wantonness, to which the abundant fertility of the first earth invited them, than in discoveries or improvements, which probably they stood much less in need of than their successors. The art of working metals was found out by the last generation of Cain's line; and music, which they might be supposed to practice for their pleasure, was not brought to any perfection, if invented, before the same generation. Some authors have supposed astronomy to have been cultivated by the Antediluvians, though this is probably owing to a mistake of Josephus; but it is to be presumed, the progress they made therein, or in any other science, was not extraordinary; it being even very doubtful whether letters were so much as known before the flood. See ALPHABET, n° 13.

As to their politics and civil constitutions, we have not so much as any circumstances whereon to build conjecture. It is probable, the patriarchal form of government, which certainly was the first, was set aside when tyranny and oppression began to take place, and much sooner among the race of Cain than that of Seth. It seems also, that their communities were but few, and consisted of vastly larger numbers of people than any form since the flood: or rather, it is a question, whether, after the union of the two great families of Seth and Cain, there were any distinction of civil societies, or diversity of regular governments, at all. It is more likely, that all mankind then made but one great nation, though living in a kind of anarchy, divided into several disorderly associations; which, as it was almost the natural consequence of their having, in all probability, but one common language, so it was a circumstance which greatly contributed to that general corruption, which otherwise perhaps could not have so universally overspread the Antediluvian world. And for this reason chiefly, as it seems, so soon as the posterity of Noah were sufficiently increased, a plurality of tongues was miraculously introduced, in order to divide them into distinct societies, and thereby prevent any such total depravation for the future. See *CONFUSION of Tongues*.

Of the condition of the Antediluvians, Mr Whitehurst, in his *Inquiry into the original state and formation of the earth*,* has given us the following picture: "Under a mild and serene sky, and when the spontaneous productions of the earth were more than sufficient for the calls of nature without art or labour, mankind had no need of any other protection from the inclemency of the seasons, nor of barns for winter's store, than the benevolent Author of nature had plentifully provided for them. Consequently, in a state of nature like this, there was no temptation to acts of violence, injustice, fraud, &c. every one having plenty and enough, each equally partook of the numerous blessings thus amply provided for him. Power and property being equally diffused, men lived together in perfect peace and harmony, without law, and without fear; therefore it may be truly said of the Antediluvians, that they slept away their time in sweet repose on the ever verdant turf. Such apparently was the state of nature in the first ages of the world, or from the creation to the first convulsion in nature, whereby the world was not only universally deluged, but reduced to a heap of ruins." But our ingenious author, whose *Inquiry* is not professedly repugnant to revelation, seems here to have lost himself in a pleasing reverie. At least he has forgot to inform us, For what purpose, under such circumstances, he supposes the deluge to have been sent upon the earth: and, How we are to understand the account given by Moses, who represents the Antediluvians, not as an innocent race, quietly reposing on the ever-verdant turf; but as a corrupt generation, by whom "the earth was filled with violence."

* P. 282, 283.

17 Of the longevity of the Antediluvians.

One of the most extraordinary circumstances, which occurs in the antediluvian history, is the vast length of human lives in those first ages, in comparison with our own. Few persons now arrive to eighty or an hundred years; whereas, before the flood, they frequently lived to near a thousand: a disproportion almost incredible, though supported by the joint testimonies of sacred and prophane writers. Some, to reconcile the matter with probability, have imagined that the ages of those first men might possibly be computed, not by solar years, but months; an expedient which reduces the length of their lives rather to a shorter period than our own. But for this there is not the least foundation; besides the many absurdities that would thence follow, such as their begetting children at about six years of age, as some of them in that case must have done, and the contraction of the whole interval between the creation and the deluge to considerably less than two hundred years, even according to the larger computation of the Septuagint.

Again: Josephus the Jewish historian, and some Christian divines, are of opinion, that before the flood, and some time after, mankind in general did not live to such a remarkable age, but only a few beloved of God, such as the patriarchs mentioned by Moses. They reason in this manner: Though the historian records the names of some men whose longevity was singular, yet that is no proof that the rest of mankind attained to the same period of life, more than that every man was then of a gigantic stature, because he says *in those days there were giants upon the earth*. Besides, had the whole of the Antediluvians lived so very long, and increased in numbers in proportion to their age, before the flood of Noah, the earth could not have contained its inhabitants, even suppposing no part of it had been sea. And had animals lived as long, and multiplied in the same manner as they have done afterwards, they would have consumed the whole produce of the globe, and the stronger would have extinguished many species of the weaker. Hence they conclude, that, for wise and good ends, God extended only the lives of the patriarchs, and a few beside, to such an extraordinary length.

But most writers maintain the longevity of mankind in general in the early world, not only upon the authority

Antediluvians. authority of sacred, but likewise of profane history. And for such a constitution, the moral reasons are abundantly obvious.

18 Moral reasons for this longevity. When the earth was wholly unpeopled, except by one pair, it was necessary to endow men with a stronger frame, and to allow them a longer continuance upon earth for peopling it with inhabitants. In the infant state of every mechanical art, relating to tillage, building, clothing, &c. it would require many years experience to invent proper tools and instruments to ease men of their labour, and by multiplied essays and experiments to bring their inventions to any degree of maturity and perfection. Every part of their work must have been exceedingly arduous from such a penury and coarseness of tools, and must have required longer time and more strength of body than afterwards, when mechanical knowledge was introduced into the world. If parents at this period had not continued long with their children, to have taught them the arts of providing for themselves, and have defended them from the attacks of wild beasts, and from other injuries to which they were exposed, many families would have been totally extinguished. But one of the best and most valuable ends which longevity would answer was, the transmitting of knowledge, particularly of religious knowledge, to mankind. And thus, before writing was invented, or any such easy and durable mode of conveyance was found out, a very few men served for many generations to instruct their posterity, who would not be at a loss to consult living and authentic records.

19 Natural causes of it. The natural causes of this longevity are variously assigned. Some have imputed it to the sobriety of the Antediluvians, and the simplicity of their diet; alleging that they had none of those provocations to gluttony, which wit and vice have since invented. Temperance might undoubtedly have some effect, but not possibly to such a degree. There have been many temperate and abstemious persons in later ages, who yet seldom have exceeded the usual period.—Others have thought, that the long lives of those inhabitants of the old world proceeded from the strength of their stamina, or first principles of their bodily constitutions: which might, indeed, be a concurrent, but not the sole and adequate cause of their longevity; for Shem, who was born before the deluge, and had all the virtue of the antediluvian constitution, fell three hundred years short of the age of his forefathers, because the greatest part of his life was passed after the flood.—Others have imputed the longevity of the Antediluvians to the excellency of these fruits, and some peculiar virtue in the herbs and plants of those days. But to this supposition it has been objected, that as the earth was cursed immediately after the fall, its productions we may suppose gradually decreased in their virtue and goodness till the flood; and yet we do not see the length of mens lives decreased considerably, if at all, during that interval. Waving this objection, as the import of the curse is variously interpreted, it appears certain that the productions of the earth were at first, and probably continued till after the deluge, of a different nature from what they were in future times. Buffon supposes this difference may have continued gradually to diminish for many ages subsequent to that catastrophe. The surface of the globe (according to his theory) was in the first ages of the world less solid and compact; because, gravity having acted only for a short time, terrestrial bodies had not acquired their present density and consistence. The produce of the earth, therefore, must have been analogous to its condition. The surface being more loose and moist, its productions would of course be more ductile and capable of extension: Their growth, therefore, and even that of the human body, would require a longer time of being completed. The softness and ductility of the bones, muscles, &c. would probably remain for a longer period, because every species of food was more soft and succulent. Hence, the full expansion of the human body, or when it was capable of generating, must have required 120 or 130 years; and the duration of life would be in proportion to the time of growth, as is uniformly the case at present: For if we suppose the age of puberty, among the first races of men, to have been 130 years, as they now arrive at that age in 14 years, the age of the Antediluvians will be in exact proportion to that of the present race; since by multiplying these two numbers by seven, for example, the age of the present race will be 90, and that of the Antediluvians will be 910. The period of man's existence, therefore, may have gradually diminished in proportion as the surface of the earth acquired more solidity by the constant action of gravity: and it is probable, that the period from the creation, to the days of David, was sufficient to give the earth all the density it was capable of receiving from the influence of gravitation; and consequently that the surface of the earth has ever since remained in the same state, and that the terms of growth in the productions of the earth, as well as the duration of life, have been invariably fixed from that period.

It has been further supposed, that a principal cause of the longevity under consideration was the wholesome constitution of the Antediluvian air, which, after the deluge, became corrupted and unwholesome, breaking, by degrees, the pristine crasis of the body, and shortening men's lives, in a very few ages, to near the present standard.

The temperature of the air and seasons before that catastrophe are, upon very probable grounds, supposed to have been constantly uniform and mild: the burning heats of summer and the severities of winter's cold were not then come forth, but spring and autumn reigned perpetually together: And indeed, the circumstances above all others most conducive to the prolongation of human life in the postdiluvian world appears to be an equal and benign temperature of climate (see the article LONGEVITY); whence it seems reasonable to infer, that the same cause might have produced the same effect in the Antediluvian world.

Whether flesh was permitted to be eaten before the deluge, is a question which has been much debated. By the permission expressly given to Noah for that purpose, after the flood, and God's assigning vegetables only for food to man, as well as beast, at the creation, one would imagine it was not lawful before: yet others have supposed, that it was included in the general grant of power and dominion given to Adam by God over the animal creation; and the distinction of beasts into clean and unclean, which was well known before the flood, is insisted on as a strong argument on this side. 20 Whether any flesh might be eaten before the flood.

But in answer to this it has been observed, that if so,

Antediluvians.

so, it doth not appear what occasion there was to renew this grant after the flood, and to add, "Every moving thing that liveth shall be meat for you, even as the green herb have I given you all things." This surely implies that the green herb and fruits of the trees were all that was granted to man at first; but now, over and above that, was added the grant of animal food: for in a deed or gift, all is specified that is given or granted, and whatever is not expressly mentioned is excluded or not given. Here man's food is appointed and specified, what is not expressly mentioned is therefore reserved and not granted. Besides, this grant or appointment of man's food respected, not Adam only, but all his posterity, till an additional grant was made.

To the animals no further grant was made than at first; but to man another was made immediately after his fall and expulsion from Paradise, implied in these words; "In the sweat of thy face shalt thou eat bread, till thou return unto the ground." This was in truth a punishment for his transgression, as well as a grant of other food, but yet what was now become necessary to him. Paradise was no doubt planted with the most excellent fruits, sufficient to have sustained his life in health and vigour in his innocent state: but after his transgression, being thrust out from that happy abode, and having then only the fruits of the common earth to feed on, which were not so nutritious as those of Paradise, he stood in need of something else to sustain life; and therefore bread produced by culture and other preparations for his food was now added, which before was not necessary, and thence called *the staff of life*. This seems a plain reason why bread was added after he came to live on the common earth; though perhaps another reason also for that addition may be given from the change that happened in man's body after his fall. Bread being now become the staff of life, Cain, the first man born, became a tiller of the ground, or an husbandman; as the next in birth, Abel, became a keeper or feeder of sheep.

As to the distinction between clean and unclean, this solely respected animals offered in sacrifice in the Antediluvian world: as is evident from hence, that Noah, upon his coming out of the ark, "took of every clean beast and of every clean fowl, and offered burnt-offerings unto the Lord;" and that upon the grant of animal food to him and his posterity, which was posterior in time to the sacrifice, there is not the least mention of any distinction between clean and unclean with respect to food, but the very contrary, since the grant runneth, "Every moving thing that liveth shall be meat for you, even as the green herb have I given you all things." That distinction of clean and unclean as to food, came in with the law of Moses, and was different from that of sacrifices, there being several creatures clean for food which were not to be offered in sacrifice.

But another objection here occurs. What occasion was there for keeping sheep, when none of them could be eaten? In answer to this, it has been observed, that sheep and other animals might at this period be of great use to men besides yielding them food. Their flocks, no doubt, consisted of such creatures as were of the domestic kind, and such as by the divine law were pronounced clean and fit for being offered in sacrifice; therefore numbers would be kept for this very purpose. Their skins, besides serving men as garments; might answer many other valuable intentions. Vestments of hair and wool soon succeeded the ruder covering of skins; consequently great profit would be derived from such animals as could be shorn, especially in countries where the inhabitants led a pastoral life and dwelt in tents. And we afterwards find that Abel's sacrifice was of this kind. They might use several of these animals, as they still do in some parts of the world, for bearing of burdens and drawing of carriages: for we may take for granted that the first inventions for easing men of labour, would be of the simplest kind, and such as came easiest to hand. But keeping flocks of sheep, goats, and such like, would be of great utility, by affording quantities of milk, which is found to be the most nourishing diet both to the young and the old; and their carcases, though not used as food, might answer some useful purposes, perhaps in manuring the soil.

21 Increase of mankind before the flood.

The Antediluvian world was, in all probability, stocked with a much greater number of inhabitants than the present earth either actually does, or perhaps is capable of containing or supplying. This seems naturally to follow from the great length of their lives, which exceeding the present standard of life in the proportion, at least, of ten to one, the Antediluvians must accordingly in any long space of time double themselves, at least in about the tenth part of the time in which mankind do now double themselves. It has been supposed that they began to beget children as early, and left off as late, in proportion, as men do now; and that the several children of the same father succeeded as quickly one after another as they usually do at this day; and as many generations, which are but successive with us, were contemporary before the flood, the number of people living on the earth at once would be by that means sufficiently increased to answer any defect which might arise from other circumstances not considered. So that, if we make a computation on these principles, we shall find, that there was a considerable number of people in the world at the death of Abel though their father Adam was not then 130 years old; and that the number of mankind before the deluge would easily amount to above one hundred thousand millions (even according to the Samaritan chronology), that is, to twenty times as many as our present earth has, in all probability, now upon it, or can well be supposed capable of maintaining in its present constitution.

The following table, made upon the abovementioned principles by Mr Whiston, shows at least what number of people might have been in the Antediluvian world.

Number of mankind.	Year of the world.	Year of doubling.	Series.
4	2	2	1
8	6	4	2
16	12	6	3
32	20	8	4
64	30	10	5
128	42	12	6
256	56	14	7

512

Antediluvians.

Number of mankind.	Year of the world.	Year of doubling.	Series.
512	72	16	8
1024	90	18	9
2048	110	20	10
4096	132	22	11
8192	156	24	12
16,384	182	26	13
32,768	210	28	14
65,536	240	30	15
131,072	272	32	16
262,144	306	34	17
524,288	342	36	18
1,048,576	380	38	19
2,097,152	420	40	20
4,194,304	462	42	21
8,388,608	506	44	22
16,777,216	552	46	23
33,554,432	600	48	24
67,108,864	650	50	25
134,217,728	702	52	26
268,435,456	756	54	27
536,870,912	812	56	28
1,073,741,824	170	58	29
2,147,483,648	930	60	30
4,294,967,296	992	62	31
8,589,934,592	1056	64	32
17,179,869,184	1122	66	33
34,359,738,368	1190	68	34
68,719,476,736	1260	70	35
137,438,953,472	1332	72	36
274,877,906,944	1406	74	37
549,755,813,888	1482	76	38

* Cockburn upon the Deluge.

But according to a later* writer upon the subject, the above table, though the numbers there may be thought sufficient for the peopling of the earth, we could by no means depend upon, for several reasons; particularly,

22
Objections to Mr Whiston's table.

1. It is laid down there as a foundation, that the Antediluvians would double themselves every 40 years; as indeed they would, and in less time, after there came to be 100 marriages. Now, had the author observed this regular progression in his computation, by adding 40 years to every former period of the age of the world, the amount, instead of two millions of millions, &c. would have been above five millions of millions at the year 1656, the age of the world at the deluge, according to the Hebrew numbers which he contends for. What would the sum then have been, had we carried on the computation for 600 years more according to the Septuagint?

2. He supposes the period of doubling must have been much shorter in the earliest ages, and much longer in the later, contrary to reason and fact. For mankind being sprung from one pair only, the increase at first must have been very slow, but come on very fast when a considerable number were married. His table therefore is made not regularly, but according to fancy, by unequal starts or chasms, at great intervals in the later part, where it should have been most regular; it would seem with no other view than to raise such a number, upon the whole, as might be thought sufficient to people the earth,

3. In that calculation the two material points, the time of nursing and the age of puberty, are quite overlooked, by which all computations of the numbers in the antediluvian world must be regulated. What unavoidable mistakes this omission must occasion, will be seen by examining the first ten numbers of the said table.

Years of the world and intervals of doubling.	Nember of increase according to the intervals.	
1	2	Adam and Eve.
2	4	Cain and Abel.
6	8	
12	16	
20	32	
30	64	
42	128	
56	256	
72	512	
90	1024	
110	2048	

On this table it may be observed, 1. That though there were but two persons created at first, this computation makes four persons in the second year of the world. This could not possibly be, except Cain had been born within 12 months after the creation, which is highly improbable, and Abel in the second year, yet far more improbable; for in that case Eve could not have suckled Cain.

Cockburn, p. 108.

2. In the sixth year of the world we have eight persons, that is, six children of Eve's in six years. "But (our author adds) what shall Eve do with six infants in six years? Where could she find so many wet nurses for them? Or would the mother of all living deny her children that nourishment which the Creator had appointed for their first food, the milk in her breasts? Do they consider that there was but one women in the world to do for herself, her husband and her children, what belongs to women to do? We should surely have more respect and compassion for the mother of all mankind, than to lay such an intolerable burden upon her, whose sorrow for her own deception, and thereby ruining both herself and her husband, must have been very great for many years. In punishment of which, though God had said *he would greatly multiply her sorrow and conception*, the meaning was not, that she should have a child every year, which could not be, because the nature of that food and nourishment appointed by himself for her children would not permit it. Nor yet when he commanded them to *increase and multiply and replenish the earth*, could the command be obeyed in such a manner as was contrary to the order of nature and providence. But the method intended to answer the design of the command was to prolong their lives to above 800 and 900 years, and their prolific powers for 340 or 360 years of that term of life, that by slow and sure and long continuance of increase they might people the earth in due time."

3. The same exception lies to all the following periods of doubling, where the number far exceeds what it could possibly be in fact; but we shall pass them over, and come to the last of them in the year 110, in which the nember of mankind is made 2048. Now in the year 110 not one of Adam's children were mar-

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ried, because not yet come to the age of puberty. In that year of the world there could be no more than 18 or 20 persons, at single births, besides Adam and Eve. It is a great mistake therefore to imagine, that the periods of doubling were much shorter in the earlier times than in the latter; the contrary of which is evident to reason.

Id. p. 81. According to our author, two errors have been fallen into in treating of this point; namely, 1. That in the first ages of the world, both before and after the Flood, men began to propagate their kind as early as they commonly do at present. 2. That the children of the same father succeeded one after another as fast as they do now, that is, that the women brought forth children every year. The first of these errors he confutes, by showing that the several periods or stages of man's life bear a just proportion to one another, and to the whole term of life; and that the period of puberty or maturity has not been the same at all times, but is according to the length or brevity of life in the different ages of the world, according to that remark of St Augustine, *Tanto serior fuit proportione pubertas, quanto vitæ totius major annositas.* Moses, he observes, gives the age of the world from the creation to the deluge, and from that period to his own time chiefly by generations. A generation is the interval of years between the births of father and son. This the Latins call *ætas*, and the Greeks γενεα. Now, a generation, or the interval of years between father and son, has not been, neither possibly could be, the same in all ages from the beginning, as Vossius justly observes; but has varied greatly according to the length or brevity of man's life in the several periods of the world. Since the ordinary term of man's life has been reduced to 70 and 80 years, the time of puberty is in proportion to this brevity of life, and reckoned at 20 or 21, which is the fourth-part of a life of fourscore. The several stages of human life are infancy, childhood, youth, manhood, full age, declension, old or decrepit age; all which commonly bear a proportion to the whole term of life. Now the bounds and limits of these several stages cannot be precisely the same in all, but vary in respect of the disposition of men's bodies, their course of life, and also the places and ages in which they live. In the Antediluvian world then, when men lived to upwards of 800 and 900 years, can it be thought that they passed through the several stages of life in as short a time as men do now, who seldom exceed 80, and not one in ten arrives at that age? But if the Antediluvians arrived at puberty or manhood as soon as men do now, then would the several stages of human life have been lost or confounded, and men would have started from childhood to manhood at once, without any due or regular intervals, contrary to the order of nature: But if, according to the present œconomy of nature, man is but a youth at 20, which is a fourth part of our term of life, we may reasonably conclude, there would be a suitable proportion of years in a much longer term of life, since nature is constant and uniform in her operations. And though in so long a life as the Antediluvians enjoyed, the time of puberty might be a fifth or a sixth part of their term of life, yet would they be but youths at 150 or 160; which bears much the same proportion to the whole of their life as 20 is to that of ours.

23 Of the ages of puberty among the Antediluvians.

The other is an error, he thinks, which could never have been fallen into, had it been considered, that every mother suckled her own children in those early days; and indeed where could she have found another to have done it for her?

Taking it for granted, then, that it was an universal custom for women to suckle their children as well before as after the food, the next question is, for how long time they continued nurses? He shews various instances, that when man's life was reduced to 130 or 140 years, the ordinary time of nursing was two years: he thence infers, that for three or four generations after the flood, when men lived to above 400 years, the time would be so much longer in proportion, and would not be less than three or four years; and consequently, that before the flood, when life was protracted to 800 or 900 years, it would be still longer in proportion to their longevity; so that five years might be the ordinary time of nursing in the Old World; and therefore that we cannot reckon less than six years between the births. For man's life being prolonged to so many hundred years at first for the more speedy peopling of the earth, he came by slow degrees to mature age, there being a long time required to rear up a body that was to last near 1000 years. The intervals therefore of infancy, childhood, youth, and mature age, were so much longer in proportion to ours as the difference is between our term of life and theirs; and 150 or 160 years, with respect to their longivity, was no more in proportion than 20 is to the brevity of our life. As the Antediluvians therefore were so very long in growing up to mature age, he concludes that the time of nursing could not be shorter than five years, and that the distance between the births in a regular way must be set at six years.

24 Of the time allotted for nursing in those early days.

25 Distance between the births.

Upon the whole, he thinks it evident that there could be no such speedy increase of mankind at the beginning as is imagined; that the time of nursing above specified was no more than necessary for that strength of constitution which was to last for 800 and 900 years; and that women who were to continue bearing children for 340 or 360 years of their life, should have them but slowly, and at the distance of several years, that their strength might hold out, and that they might not be overburthened with too many cares at once; and therefore, when Eve's first child was six years old, it was time enough for her to have another, and so on, though possibly sometimes twins.

These points being discussed, he proceeds, 1. To compute what number upon the whole might be born into the world from the creation to near the time of the deluge; and then, 2. To state the needful deductions for deaths and other deficiencies.

25 Cockburn's calculation of the increase of mankind.

I. 1. How long the parents of mankind continued in paradise, we know not; though longer perhaps than is commonly imagined. We shall even suppose two or three years, in which time there was no child born, nor any attempt towards it. We shall allow them two or three years more to lament their fall, and the miserable estate their want of faith and disobedience had brought them to, from a most happy condition; and suppose Cain to be born six years after the creation (in which supposition few, probably, will be apt to think us too hasty), and Abel again six years after him, and so every sixth year Eve to have had a child, the first

seven

Antediluvians.

seven, eight or nine whereof were probably all males (the males being longer in coming to maturity than the females); and this distance between the births will also be thought a sufficient allowance. At this rate of increase Adam would have in 100 years 16 children, in 200 years 32, and in 400 years 64 children; when we will suppose Eve to have left off child-bearing. Nor need this number of Adam's children be thought too great, when there are instances in these later ages, and this short period of man's life, of those who have had 40 children at single births by two successive wives, and of many others who have had 20, 25, and 30, by one wife; though in such cases it is not to be supposed that the women suckled their children.

2. Though it is reasonable to think that the Antediluvians, notwithstanding their longevity, came to mature age at 150; yet as we are not sure that they all married so soon as they were ripe for marriage, and that the earliest in the genealogies is born in the 162d year of his father, who might probably be a first-born, our author does not suppose Cain, Abel, or any of the succeeding children or grandchildren of Adam to have married till they were 160, but to have had children from 161 or 162 till they were of the age of 500, at the fore-named distance or interval between the births; though Noah we know had three sons after he was 500, at the due intervals. And to all the Antediluvians we may allow, without fear of exceeding, 50 or 54 children in general, according to the course of nature, and the longevity of those first ages of the world.

3. Let us next inquire in what number of years the men of that world might double themselves, notwithstanding the long interval between the births. The increase indeed will be found very small for the first 300 or 400 years, as they were late in coming to maturity; but the succeeding ages will swell the account exceedingly. Let us suppose at present (what shall be proved afterwards) that in the year of the world 500, there were 200 persons only, male and female, of full age to marry, the men at 160, the women at 120 or thereabout. The first or second year after the marriage will probably produce 100 births from 100 couple, and every sixth year after 100 more. At this slow progression the 200 married persons will, in 19 or 20 years, be increased to 600: so that the number of mankind would be trebled in 20 years, after there came 100 pair to be married. And in this manner they would increase and multiply every 20 years, or in that space treble themselves.

It may perhaps be objected, that though it appears that such an increase might be at first from the first 100 marriages, yet they could not continue thus to multiply at such periods; because, according to the rule we have laid down, none of the issue of these 100 first marriages could increase the number of mankind till the men had attained the age of 160. It is true they could not: but then it must be remembred, that the first 100 pair are still adding every sixth year 100 more to the number of mankind, even till after the 400 born in the first 20 years are married, and begin a new stock for increase; so that when there came to be some hundred couples married, the increase and multiplication would come on very fast, and in 1000 years mankind would be prodigiously increased.

But though there be nothing in this supposition contrary to reason, viz. That after the year of the World 500, they might treble themselves in 20 years; yet we will not reckon upon so short an interval, but will allow a much longer time even to their doubling themselves, and shall exhibit two tables of doubling; the first at the interval of 50 years (much too long indeed), the other at the interval of 40 years, and both beginning at the year 500, when there could not be fewer (whatever more there might be) than 100 married or marriageable persons descended from Adam and Eve.

Years of the World.	Number of Mankind.
500	200
550	400
600	800
650	1,600
700	3,200
750	6,400
800	12,800
850	25,600
900	51,200
950	102,400
1,000	204,800
1,050	409,600
1,100	819,200
1,150	1,638,400
1,200	3,276,800
1,250	6,553,600
1,300	13,107,200
1,350	26,214,400
1,400	52,428,800
1,450	104,857,600
1,500	209,715,200
1,550	419,430,400
1,600	838,860,800
1,650	1,677,721,600
1,700	3,355,443,200
1,750	6,710,886,400
1,800	13,421,772,800
1,850	26,843,545,600
1,900	53,687,091,200
1,950	107,374,182,400
2,000	214,748,364,800
2,050	429,496,729,600

This table is calculated at the long interval of 50 years, that it may appear that even by under-rating the number of mankind, there would be so many millions born into the world before the deluge came, that they would be obliged to spread themselves over the face of the earth, though but one half of the sum total of 429,496 millions had been alive at the time of the deluge; but as the interval here allowed may appear to be too long for the time of doubling, the second is calculated at the interval of 40 years, which comes nearer to the truth of the case, though even this may exceed the time of doubling.

Years of the World.	Number of Mankind.
500	200
540	400
580	800
620	1,600
660	3,200
700	6,400

740

Years of the World.	Numbers of Mankind.
740	12,800
780	25,600
820	51,200
860	102,400
900	204,800
940	409,600
980	819,200
1,020	1,638,400
1,060	3,276,800
1,100	6,553,600
1,140	13,107,200
1,180	26,214,400
1,220	52,428,800
1,260	104,857,600
1,300	209,715,200
1,340	419,430,400
1,380	838,860,800
1,420	1,677,721,600
1,460	3,355,443,200
1,500	6,710,886,400
1,540	13,421,772,800
1,580	26,843,545,600
1,620	53,687,091,200
1,660	107,374,182,400
1,700	214,748,364,800
1,740	429,496,729,600
1,780	858,993,459,200
1,820	1,717,986,918,400
1,860	3,435,973,836,800
1,900	6,871,947,673,600
1,940	13,743,895,347,200
1,980	27,487,790,694,400
2,020	54,975,581,388,800

The first table is brought down no lower than to the year 2050, and the second to the year 2020, though there remain by the first 206, and by the second 236 years to the flood: the reason is, that in those last 200 years of the world, mankind would not increase in any measure equal to what they had done in the preceeding years (though regularly the increase should have been much greater): because that violence was then great in the earth, and thousands, yea, millions, might have been cut off by untimely deaths; for which cause the worlds destruction was determined 120 years before the flood came.

27 Objection answered. II. But now against this immense number of mankind that might in a regular and ordinary way have been born in the world between the creation and the deluge in 2056 years, it will no doubt be objected by some (as it has been done to far less numbers,) that all such calculations are mere guess-work, the product of fruitful imaginations.

But it should be considered, that in calculations of this nature some regular order or method must be observed: and though, according to the course of nature, such an increase and multiplication of mankind there might have been periodically, especially at the beginning, when the command was *to increase and multiply and replenish the earth;* yet we will not suppose that all things went on thus regularly, without difference or interruption. We do not know what extraordinary obstructions or interruptions there might be to such a regular increase. Though every married pair might by the course of nature have had such a number of children as has been mentioned, yet the Divine Providence might order it otherwise in manifold instances, and it might possibly be in the Old World as it has been since the flood, viz. that some marriages have produced many children, others few, and some none at all. Allowing therefore for all such obstructions and deficiencies, and likewise for all casualties and accidents (to which men might be liable in that world as well as in the present), in as ample a manner as can be desired, let the former number be reduced to one half, viz. to 27,487,790,694,400, that is, 27 billions, or millions of millions, four hundred and eighty-seven thousand seven hundred and ninety millions, six hundred and ninety-four thousand and four hundred. And this we shall now suppose to be the whole number of those who were born into the world before the deluge. But from this sum is to be subtracted the number of those who died before that time.

Of those in the genealogies from Adam by Seth, Enoch was translated at the age of 365, and Lamech the father of Noah died just before the flood at 753, Mahalaleel at 895. Adam and the other five patriarchs lived to above 900. Before the year 900 therefore, we may suppose there were no deaths except that of Abel, who was slain, a young man, but that all born within that period were alive together. But in the tenth century death began to reign, and Adam and Eve we may presume were the first over whom death had power in a natural way, as their disobedience was the cause of it. The children also born of them in the first hundred years would also die in this 10th century, those born in the second hundred would die in the 11th, those born in the third century would die in the 12th, and so on. But though we are far from thinking that after the beginning of the 10th century (till which time few or none died), the deaths would be equal to the births; yet as we have made large concessions all along, we shall do the same in this case, and suppose them upon the whole to have been equal, especially since we cannot precisely say how soon that violence or blood-shed, which was their crying sin, came to prevail; and therefore will reduce the last sum mentioned to one half again, to allow for the deaths and prevailing violence, and suppose the total number of mankind alive upon earth at the time of the deluge to have been no more than 13,743,895,347,200, that is, 13 billions, or millions of millions, seven hundred and forty-three thousand eight hundred and ninety-five millions, three hundred and forty-seven thousand and two hundred; a number vastly exceeding that of the present inhabitants of the whole earth.

28 Probability of the above calculation. Notwithstanding the very large allowances and abatements made to reduce the number of mankind, yet even the last reduction to 13 billions, or millions of millions, &c. seems so vastly great, that it will hardly be thought possible that such a number of men could ever be at one time upon the earth. Now, though we pretend to no certainty in this point (which made it the more requisite to allow largely for deaths and deficiencies), yet the calculation we have given must appear highly probable, since it is founded on grounds certain and undeniable: for instance,

1. It

1. It cannot be denied but that the Antediluvians were come to the age of puberty and marriage at 160 years, when we find a son born in 162. Nor,

2. Can it be said, that they could not have children at the age of 500, when we have an instance of one that had three sons at due distances after that age. Neither,

3. Can it be alleged that we have not allowed a due distance or interval between the births, viz. six years, when most will be opinion that it could not be so long. Nor yet,

4. Can it be judged that we have made the period of doubling far too short, when we had before showed that after 100 marriages consummated, they would treble themselves in half the time we have taken for their doubling. Nor,

5. Will any one make a doubt, but that there might be 200 persons of mature age for marriage in the year of the world 500, the men at 160, the women younger. Nevertheless, as this is the foundation of our calculation, we shall now show that there was at least such a number of persons marriageable at that age of the world.

It may be observed, that as we take 160 for the year of maturity and marriage, according to that period all married or marriageable in the year 500 must have been born in or before the year 340; the males at least, though the females coming sooner to maturity, might some of them be born later or after the year 380. Now, according to this stated period of marriage,

1. In or before the year 340, Adam might have had 54 children, males and females, or 27 pair married or fit for marriage.

2. Cain, whom we suppose to be but six years younger than Adam (which by the by is more than others allow), and to have married in the year 166, might have in the year 340, 28 children, or 14 pair fit for marriage; which added to the former, makes 41 pair.

3. Abel married six years later, that is, in the year 172. and whom we shall suppose slain in the year 225 or 226, could in that case have no more than eight or nine children, or four pair, which with the former make 45 pair.

4. Adam's third son married in the year 178, will afford us in the year 340, 26 children, or 13 pair, which increase the number of marriageable persons to 58 pair.

5. A fourth son of Adam's married in the year 184, will give us in the year 340, 25 children, or 12 pair; which makes the number of pairs 70.

6. A fifth son of Adam's married in the year 190, might in the year 340 have 24 children, or 12 pair again, which increase the former number to 82 pair.

7. A sixth son of Adam's married in the year 196, would have in the year 340, 22 children, or 11 pair; which added to the former make up 93 pair.

8. A seventh son of Adam's married in the year 202, will, in the year 340, give us 20 children, or 10 pair; which makes in the whole 103 pair, already three pair more than we reckoned upon. I need therefore go no farther on to the eighth or ninth son; but the following eight or nine births I may reasonably take to have been daughters, and married to the brothers that preceded them.

Here are now no more than 14 children of Adam's married, who have given us the 100 pair we have reckoned upon, and three over. We might yet have 13 pair to bring into the account, all born before the year 340, and marriageable in the year 500, which would very much increase the number of mankind. And by this the reader may perceive that we have been far from building on uncertain or precarious foundations, since we have omitted 13 pair more, which we might have taken into the account. And if it be considered that the command given to Adam was to increase and multiply and replenish the earth, no doubt can be made, but that his own and his childrens marriages were fruitful in the procreation of children that the earth might be inhabited.

ANTEGO. See Antigua.

ANTEJURAMENTUM, by our ancestors called *juramentum calumniæ*, an oath which anciently both accuser and accused were to take before any trial or purgation.—The accuser was to swear that he would prosecute the criminal; and the accused to make oath, on the day he was to undergo the ordeal, that he was innocent of the crime charged against him.

ANTELOPE, in zoology. See Capra.

ANTELUCAN, in ecclesiastical writers, is applied to things done in the night or before day. We find frequent mention of the antelucan assemblies *(Cœtus antelucani)* of the ancient Christians in times of persecution for religious worship.

ANTEMURALE, in the ancient military art, denotes much the same with what the moderns call an *out-work*.

ANTENATI, in modern English history, is chiefly understood of the subjects of Scotland, born before king James the Frist's accession to the English crown, and alive after it. In relation to these, those who were born after the accession were denominated *Postnati*. The antenati were considered as aliens in England, whereas the postnati claimed the privilege of natural subjects.

ANTENCLEMA, in oratory, is where the whole defence of the person accused turns on criminating the accuser. Such is the defence of Orestes, or the oration for Milo: *Occisus est, sed latro. Exsectus, sed raptor.*

ANTENICENE, in ecclesiastical writers, denotes a thing or person prior to the first council of Nice. We say the Antenicene faith, Antenicene creeds, Antenicene fathers.

ANTENNÆ, in the history of insects, slender bodies with which nature has furnished the heads of these creatures, being the same with what in English are called *horns* or *feelers*. See Entomology.

ANTENOR, a Trojan prince, came into Italy, expelled the Enganians on the river Po, and built the city of Padua, where his tomb is said to be still extant.

ANTEPAGMENTA, in the ancient architecture, the jams of a door. They are also ornaments, or garnishings, in carved work, of men, animals, &c. made either of wood or stone, and set on the architrave.

ANTEPENULTIMA, in grammar, the third syllable of a word from the end, or the last syllable but two.

ANTEPILANI, in the Roman armies, a name given to the hastati and principes, because they marched next before the triarii, who were called *pilani*.

ANTEPILEPTICS, among physicians, medicines esteemed good in the epilepsy.

ANTEPOSITION, a grammatical figure, whereby a word, which by the ordinary rules of syntax ought to follow another, comes before it. As when, in the Latin, the adjective is put before the substantive, the verb before the nominative case, &c.

ANTEPREDICAMENTS, among logicians, certain preliminary questions which illustrate the doctrine of predicaments and categories.

ANTEQUIERA, a handsome town of Spain, in the kingdom of Granada, divided into two parts, the upper and the lower. The upper is seated on a hill, and has a castle: the lower stands in a fertile plain, and is watered with a great number of brooks. There is a large quantity of salt in the mountain; and five miles from the town, a spring famous for the cure of the gravel. W. Long. 4. 40. N. Lat. 36. 51.

ANTERIOR, denotes something placed before another, either with respect to time or place.

ANTEROS, in mythology, one of the two Cupids who were the chief of the number. They are placed at the foot of the Venus of Medici; this is represented with a heavy and sullen look, agreeably to the poetical description of him, as the cause of love's ceasing. The other was called Eros.

ANTESIGNANI, in the Roman armies, soldiers placed before the standards, in order to defend them, according to Limpsius; but Cæsar and Livy mention the antesignani as the first line, or first body, of heavy armed troops. The velites, who used to skirmish before the army, were likewise called *antesignani*.

ANTESTATURE, in fortification, a small retrenchment made of palisadoes, or sacs of earth, with a view to dispute with an enemy the remainder of a piece of ground.

ANTESTARI, in Roman antiquity, signifies to bear witness against any one who refused to make his appearance in the Roman courts of judicature, on the day appointed, and according to the tenor of his bail. The plaintiff, finding the defendant after such a breach of his engagement, was allowed to carry him into court by force, having first asked any of the persons present to bear witness. The person asked to bear witness in this case, expressed his consent by turning his right ear, which was instantly taken hold of by the plaintiff, and this was to answer the end of a subpœna. The ear was touched upon this occasion, says Pliny, as being the seat of memory, and therefore the ceremony was a sort of caution to the party to remember his engagement.

ANTEVIRGILIAN HUSBANDRY, an appellation given to Mr. Tull's new method of horse-hoeing husbandry. See AGRICULTURE.

ANTHELION, See CORONA and PARHELION.

ANTHELIX, in anatomy, the inward protuberance of the external ear, being a semicircle within, and almost parallel to the helix. See ANATOMY.

ANTHELMINTICS, among physicians, medicines proper to destroy worms.

ANTHEM, a church-song, performed in cathedral-service by choristers, who sung aternately. It was used to denote both psalms and hymns, when performed in this manner. But at present, anthem is used in a more confined sense, being applied to certain passages taken out of the scriptures, and adapted to a particular solemnity. Anthems were first introduced in the reformed service of the English church, in the beginning of the reign of Queen Elizabeth.

ANTHEMIS, CAMOMILE: A genus of the polygamia superflua order, belonging to the syngenesia class of plants; and in the natural method ranking under the 49th order, *Compositæ discoides*. The essential characters are these: The receptaculum is chaffy; there is no pappus; the calyx is hemispheric and subequal; and the florets of the ray are more than five. Of this genus Linnæus enumerates 17.

Species; of which the most remarkable are the following. 1. The nobilis, or common camomile, grows in plenty upon commons, and other waste land. It is a trailing perennial plant, which puts out roots from the branches, by which it spreads and multiplies greatly. Of this kind there is a variety with double leaves.—Formerly this plant was used for planting of walks; which, when mowed and rolled, looked well for some time; but as it was subject to decay in large patches, the walks became unsightly, and it was therefore disused. 2. The pyrethrum, or pellitory of Spain, is a perennial plant, which grows naturally in Spain and Portugal, from whence the roots are brought to Britain. The branches trail upon the ground, and spread a foot or more each way; these are garnished with fine winged leaves like those of the common camomile. At the extremity of each branch is produced one large single flower, like a camomile, but much larger; the rays of which are of a pure white within, but purple on the outside. After the flowers are past, the receptacle swells to a large scaly cone, having the seeds lodged between its scales; but unless the season is dry, the seeds will not come to perfection in Britain. 3. The tinctoria, with sawed winged leaves, is a perennial plant, which flowers from June to November, and makes a very pretty appearance, some of the flowers being of a white, others of a sulphur, and some of a bright yellow colour. 4. The Arabica, with a branching empalement. The seeds of this species were brought from Africa by the late Dr Shaw, and distributed to many curious botanists in Britain and other countries of Europe. It grows neat two feet high, with an upright stem, having a single flower at the top, from whose empalement there are two or three footstalks put out horizontally, about two inches long, each having a single flower smaller than the first, like the childing marigold, or hen-and-chicken daisy.

Culture. The first sort may be very easily propagated by procuring a few slips in the spring, and planting them about a foot distant from one another, where they will soon cover the ground. The other sorts may be propagated from seeds sown in the spring, and will require no other care than to be kept free from weeds: only the third sort must be transplanted when come up from the seeds into borders near shrubs, where they may have room to grow; for they spread very wide, and therefore require to be placed three feet distant from other plants.

Medicinal Uses. The first and second sorts are used in medicine. The first have a strong, not ungrateful, aromatic smell, and a very bitter nauseous taste. They are accounted carminative, aperient, emollient, and in some measure anodyne; and stand recommended in flatulent

tulent colics, for promoting the uterine purgations in spasmodic pains, and the pains of child-bed-women: sometimes they have been employed in intermittent fevers, and the nephritis. These flowers are frequently also used externally in discutient and antiseptic fomentations, and in emollient glysters. They enter the *decoctum pro enemate* and *decoctum pro fomento* of our pharmacopoeias. An essential oil was formerly directed to be prepared from them, but it is now omitted. A simple watery infusion of them taken in a tepid state, is at present frequently employed to promote the operation of emetics. The root of the pyrethrum is the only part endowed with medical virtue. It has no sensible smell; its taste is very hot and acrid, but less so than that of arum or dracunculus: the juice expressed from it has scarce any acrimony, nor is the root itself so pungent when fresh as after it has been dried. Water, assisted by heat, extracts some share of its taste, rectified spirit the whole; neither of them elevate any thing in distillation. The principal use of pyrethrum in the present practice is as a masticatory, for promoting the salival flux, and evacuating viscid humours from the head and neighbouring parts; by this means it often relieves the tooth-ach, some kinds of pains of the head, and lethargic complaints.

ANTHERA, among botanists, that part of the stamen which is fixed on the top of the filamentum, within the corolla: it contains the pollen or fine dust, which, when mature, it emits for the impregnation of the plant, according to Linnæus. The APEX of Ray, Tournef. & Rivin.; *Capsula staminis*, of Malpighi.

ANTHERICUM, SPIDER-WORT: A genus of the monogynia order, belonging to the hexandria class of plants; and in the natural method, ranking under the 10th order, *Coronariæ*. The characters are: There is no *calyx*: The *corolla* consists of six oblong petals, which are expanding: The *stamina* consist of six subulated erect filaments; the antheræ are small and furrowed: The *pistillum* has a three-cornered germen, a simple stylus, and obtuse stigma: The *pericarpium* is an ovate trisulcated capsule, with three cells and three valves: The *seeds* are numerous and angular. Of this genus Linnæus reckons up nine.

Species. But only the three following seem to deserve notice. 1. The ramosum, with a branching stalk. 2. The iliago. These are perennial plants, which are natives of Spain, Portugal, and other warm countries. They were formerly pretty common in the English gardens; but the severe winter of 1740 killed most of their roots. They flower in June and July, and the seeds are ripe in September. 3. The frutescens, with a shrubby stalk, was formerly known among the gardeners near London by the name of *onion-leaved aloe*. It produces many ligneous branches from the root, each supporting a plant with long taper leaves, in shape like those of an onion, and full of a yellow pulp very juicy. These plants send out roots, which run down and fasten themselves into the earth, by which they multiply greatly. The flowers are produced on long loose spikes, are yellow, and appear at different times, so that the plants are never long destitute of flowers. This species is a native of the Cape of Good Hope.

Culture. The two first are propagated by seeds, which should be sown in the autumn, in a warm situation, on a bed of light sandy earth. When the plants come up they must be kept clear of weeds during the summer; and in autumn, when the leaves decay, they should be carefully taken up and transplanted into a bed of light earth, at a foot distance from one another. If the winter prove severe, they should be covered with straw, pease-haulm, or old tan. The third likewise requires shelter in winter; though some of them will live in the open air, if planted close to the warm wall.

ANTHESPHORIA, in antiquity, a Sicilian festival instituted in honour of Proserpine. The word is derived from the Greek ανθος, *flower*, and φερω, *I carry*; because that goddess was carried away by Pluto when she was gathering flowers in the fields. Yet Festus does not ascribe the feast to Proserpine; but says it was thus called by reason ears of corn were carried on this day to the temples.—Anthesphoria seems to be the same thing with the *florisertum* of the Latins, and answers to the harvest-home among us.

ANTHESTERIA, in antiquity, was a feast celebrated by the Athenians in honour of Bacchus. The most natural derivation of the word is from the Greek ανθος (*flos*), a flower, it being the custom at this feast to offer garlands of flowers to Bacchus.

The Anthesteria lasted three days, the 11th, 12th, and 13th of the month; each of which had a name suited to the proper office of the day. The first day of the feast was called πιθοιγια, i. e. *opening of the vessels*: because on this day they tapped the vessels, and tasted the wine. The second day they called χοες, *congii*, the name of a measure containing the weight of 10 pounds; on this they drank the wine prepared the day before. The third day they called χυτροι, *kettles*: on this day they boiled all sorts of pulse in kettles; which however they were not allowed to taste, as being offered to Mercury.

ANTHESTERION, in ancient chronology, the sixth month of the Athenian year. It contained 29 days; and answered to the latter part of our November and beginning of December. The Macedonians called it *dæsion* or *desion*. It had its name from the festival antheresteria kept in it.

ANTHISTIRIA, in botany: A genus of the trigynia order, belonging to the triandria class of plants; and, in the natural method, ranking under the 4th order, *Gramina*. The characters are: The *calyx* is a four-valved glume equally cleft to the base: The *corolla* is a two-valved glume: The *stamina* consist of three short slender filaments, the antheræ oblong and erect: The *pistillum* has an oblong germen; the styli are two; and the stigmata are clavated and and hairy: There is no *pericarpium*, except a closed calyx: The *seed* is oblong and furrowed. There is only one species of this grass, the ciliata or fringed anthistiria, a native of India.

ANTHOCEROS, or HORN-FLOWER: A genus of the order of algæ, belongingingto the cryptogamia class of plants; and, in the natural method, ranking under the 57th order, *Algæ*. The essential characters are: The calyx of the *male* is sessile, cylindric, and entire; the antheræ (one) is subulated, very long, and two-valved: The calyx of the *female* is monophyllous, divided into six parts, and expanding: The seeds are about three, naked and roundish.—There are only three species of the anthoceros, viz. the punctatus or spotted anthoceros, a native of Britain; the lævis, a native of Europe

Europe and America; and the multifides, a native of Germany. It is found in moist shady places, and on heaths.

ANTHOLOGION, the title of the service-book used in the Greek church. It is divided into 12 months, containing the offices sung throughout the year, on the festivals of our Saviour, the Virgin, and other remarkable saints.

ANTHOLOGY, a discourse of flowers, or of beautiful passages from any authors.—It is also the name given to a collection of epigrams taken from several Greek poets.

ANTHOLYZA, MAD-FLOWER: A genus of the monogynia order, belonging to the triandria class of plants; and in the natural method ranking under the 6th order, *Ensatæ*. The essential characters are these: The calyx is tubular, irregular, and bent back; and the capsule is beneath the flower.

Species. 1. The ringens, whose flower-slips spread asunder. This hath red, round, bulbous roots, from which arise several rough furrowed leaves, near a foot long, and half an inch broad: between these comes out the flower-stalk immediately from the root, which rises two feet high, is hairy, and hath several red flowers coming out on each side. These appear in June, and the seeds ripen in September. 2. The spicata, with narrow furrowed leaves, is in shape and size like the vernal crocus, but the outer skin is thin and white; from this arise five or six long narrow leaves, which are deeply furrowed. Between these arise the flower-stem, which is a foot and a half high, bending on one side towards the top, where the flowers come out on one side, standing erect. They are of a white colour, appear in May, and the seeds ripen in August. Both these species are natives of Africa, from whence their seeds were first obtained, and raised in the Dutch gardens.

Culture. The antholyza may be propagated by offsets, which it sends off in pretty great plenty; or by seeds, which are sometimes perfected in Europe. These should be sown soon after they are ripe, in pots of light earth; which, if plunged in old beds of tan which has lost its heat, and shaded in the middle of the day in hot weather, they will come up the following winter: therefore they must be kept covered with glasses to screen them from cold, otherwise the young plants will be destroyed. They may remain in the pots two years, if the plants are not too close, when they will have acquired strength enough to bear transplanting; the proper time for which is in July and August, when their leaves are decayed. In summer the pots may be placed in the open air, but in winter they must be placed under a hot-bed frame; or in the green-house, where they are a great ornament when in flower.

ANTHONY (St), was born in Egypt in 251, and inherited a large fortune, which he distributed among his neighbours and the poor, retired into solitude, founded a religious order, built many monasteries, and died *anno* 356. Many ridiculous stories are told of his conflicts with the devil and of his miracles. There are seven epistles extant attributed to him.

St Anthony is sometimes represented with a fire by his side, signifying that he relieves persons from the inflammation called after his name; but always accompanied by a hog, on account of his having been a swine-herd, and curing all disorders in that animal. To do him the greater honour, the Romanists in several places keep at common charges a hog denominated *St Antony's hog*, for which they have great veneration. Some will have St Antony's picture on the walls of their houses, hoping by that to be preserved from the plague; and the Italians, who do not know the true signification of the fire painted at the side of their saint, concluding that he preserves houses from being burnt, invoke him on such occasions. Both painters and poets have made very free with this saint and his followers: the former by the many ludicrous pictures of his temptation; and the latter, by divers epigrams on his disciples or friars; one of which is the following, printed in Stephens's World of Wonders:

Once fedd'st thou, Anthony, an herd of swine,
  And now an herd of monks thou feedest still.
For wit and gut alike both charges bin;
  Both loven filth alike; both like to fill
Their greedy paunch alike: nor was that kind
More beastly, sottish, swinish, than this last.
All else agrees: one fault I only find,
  Thou feedest not thy monks with oaken mast.

ANTHONY, or *Knights of St ANTHONY*, a military order, instituted by Albert Duke of Bavaria, Holland, and Zealand, when he designed to make war against the Turks in 1382. The knights wore a collar of gold made in form of a hermit's girdle, from which hung a stick cut like a crutch, with a little bell, as they are represented in St Antony's pictures.

St ANTHONY also gives the denomination to an order of religious founded in France about the year 1095, to take care of those afflicted with St Anthony's fire, (see the next article.)—It is said, that, in some places, these monks assume to themselves a power of giving, as well as removing, the *ignis sacer*, or erysipelas; a power which stands them in great stead for keeping the poor people in subjection, and extorting alms. To avoid the menaces of these monks, the country people present them every year with a fat hog a-piece. Some prelates endeavoured to persuade Pope Paul III. to abolish the order; *quæstuarios istos sancti Anthonii, qui decipiunt rusticos et simplices, eosque innumeris superstitionibus implicent, de medio tollendos esse.* But they subsist notwithstanding, to this day in several places.

St ANTHONY's Fire, a name popularly given to the erysipelas. Apparently it took this denomination, as those afflicted with it made their peculiar application to St Anthony of Padua for a cure. It is known, that anciently particular diseases had their peculiar saints: thus, in the ophthalmia, persons had recourse to St Lucia; in the tooth-ach, to St Apollonia; in the hydrophobia, to St Hubert, &c.

ANTHORA, in botany, the trivial name of a species of Aconitum. See ACONITUM.

ANTHORISMUS, in rhetoric, denotes a contrary description or definition of a thing from that given by the adverse party.—Thus, if the plaintiff urge, that to take any think away from another without his knowledge or consent, is a thief; this is called ὁρος, or definition. If the defendant reply, that to take a thing away from another without his knowledge or consent, provided it be done with design to return it to him again, is not theft; this is an Ανθορισμος.

Anthospermum ‖ Anthropolatria.

ANTHOSPERMUM, the AMBER-TREE: A genus of the diœcia order, belonging to the polygamia class of plants; and in the natural method ranking under the 47th order, *Stellatæ*. The essential characters are: The calyx of the hermaphrodite flower is divided into four parts; there is no corolla; the stamina are four, and the pistilli two; the germen is beneath the flower. Male and female on the same and separate plants.

Species. Of this genus Linnæus mentions three; the Æthiopica, ciliare, and herbacea; but the first is most generally known in the gardens of the curious. Its beauty consists in its small evergreen leaves, which grow as close as heath. These being bruised between the fingers, emit a very fragrant odour; whence the name amber-tree.

Culture. This plant is easily propagated by cuttings during any of the summer-months, in a border of light earth; where they will take root in six weeks time, provided they are watered or shaded as the season may require; or if they are planted in pots plunged in a moderate hot-bed, they will take root the sooner, and there will be a greater certainty of their growing. They must be frequently renewed by cuttings, as the old plants are very subject to decay, and seldom last above three or four years.

ANTHOXANTHUM, or VERNAL-GRASS: A genus of the digynia order, belonging to the diandria class of plants; and in the natural method ranking under the 4th order, *Gramina*. The essential characters are: The calyx is a bivalved gluma, with one flower; the corolla is bivalved, obtuse, and without any awn.

There are three species of anthoxanthum; viz. the odoratum, or spring-grass, a native of Britain; the indicum, a native of India; and the paniculatum, a native of the southern parts of Europe. The odoratum is one of the earliest spring grasses, and is extremely common in our fertile pastures. The delightful smell of new-mown hay is chiefly from this plant. Cows, horses, sheep, and goats eat it.

ANTHRACIS, ANTHRACIAS, or ANTHRACITIS, names promiscuously used by ancient naturalists for very different fossils; viz. the carbuncle, hæmatites, and a kind of asteria. See CARBUNCLE, &c.

ANTHRACOSIS, in medicine, a corrosive scaly ulcer either in the bulb of the eye or the eye-lids.

ANTHRAX, a Greek term, literally signifying a burning coal, used by the ancients to denote a gem, as well as a disease, more generally known by the name of *carbuncle*.

ANTHRAX is sometimes also used for lithanthrax or pitcoal. See LITHRANTHRAX.

ANTHROPOGLOTTUS, among zoologists, an appellation given to such animals as have tongues resembling that of mankind, particularly to the parrot kind.

ANTHROPOGRAPHY, denotes the description of the human body, its parts, structure, &c. See ANATOMY.

ANTHROPOLATRÆ, in church-history, an appellation given to the Nestorians, on account of their worshipping Christ, notwithstanding that they believed him to be a mere man.

ANTHROPOLATRIA, the paying divine honours to a man; supposed to be the most ancient kind of idolatry.

Anthropolites.

ANTHROPOLITES, a term denoting petrifactions of the human body, as those of quadrupeds are called *zoolites*.

It has been doubted whether any real human petrifactions ever occur, and whether those which have been supposed such were not mere *lusus naturæ*. But the generality of naturalists best versed in this branch assures us of real anthropolites being sometimes found. And indeed, as it is universally admitted that the zoolites are frequently seen, what negative argument therefore can be brought against the existence of the others? Are not the component parts of the human body nearly similar to those of the brute creation? Consequently, correspondent matter may be subject to, and acquire, the like accidental changes, wherever the same power or causes concur to act upon either object. If the former are not so common, it may be accounted for, in some measure, by reflecting that human bodies are generally deposited in select and appropriated places; whereas the bones of animals are dispersed every where, and falling into various beds of earth, at a greater or less depth, there is more probability of their encountering the petrifying agent. Could we credit some authors who have treated on this subject, they will tell us of entire bodies and skeletons that were found petrified. One in particular, discovered at Aix in Provence *anno* 1583, in a rocky cliff, the cerebrum whereof, when struck against a piece of steel, produced sparks, the bones being at the same time friable. The reports of Happel and Kircher are too absurd for belief. Van Helmont's strange relations, together with those of a Jean a Costa, must also be rejected as fabulous. Scheuhzer has published an engraved figure, which he calls the *Antediluvian man*: how far it is authentic, it would be rash to say. It is, however, asserted by many respectable writers on natural history, that whole skeletons petrified have been brought to light from certain old mines, which remained closed up and disused for several centuries. These indeed are acknowledged to be very rare. Yet it is a known fact, that detached parts, osteolithi, are sometimes found, especially in situations where either the water, the soil, or both, have been observed to possess a strong putrescent quality. The human vertebræ, fragments or portions of the tibia, and even the whole cranium itself, have been seen in an absolute state of petrification. Some of these are said to appear vitriolated or mineralized. As to the petrified bones of pretended giants, they are more probably real zoolites, the bones of the larger animals. All these bones are found in various states, and under different appearances. Some are only indurated; others calcined, vitriolated, or mineralized; some, again, are simply incrusted; whilst others have been proved completely petrified. Notwithstanding what is here advanced, it may be granted that a positive *lusus naturæ*, in some hands, is repeatedly mistaken for a real petrification. They are, however, distinguishable at all times by an experienced naturalist; particularly by the following rules: First, We may determine that fossil a *lusus naturæ* which, on a strict examination, is observed to deviate in any material degree from the true *res analogica existens*. Secondly, By the same parity of reasoning, those fossil shells are to be esteemed certain petrifications, and genuine Antediluvian *reliquiæ*, in which, on a compari-

son

fon with their *analogues* collected from the fea, there appears an exact conformity in fize and figure. This comparative obfervation will hold good for all foffils; that is, fuch as prefent themfelves either under the animal or vegetable form. It is neverthelefs worthy of notice, that all teftaceous foffils are not petrified; fince fome kinds of them have been found in beds of fand, which retained their original perfect fhape and quality, but at the fame time they proved very brittle, indeed fcarcely bearing the moft gentle touch. Shells of this defcription are always diffoluble by acids, in contradiftinction to the petrified or calcareous foffil fhells whofe property it is to refift the action of fuch like *menftrua*. See further the article PETRIFACTION.

ANTHROPOLOGY, a difcourfe upon human nature.

ANTHROPOLOGY, among divines, denotes that manner of expreffion by which the infpired writers attribute human parts and paffions to God.

ANTHROPOMANCY, a fpecies of divination, performed by infpecting the intrails of a human creature.

ANTHROPOMORPHA, a term formerly given to the primates of that clafs of animals which have the greateft refemblance to the human kind.

ANTHROPOMORPHISM, among ecclefiaftical writers, denotes the herefy or error of the Anthropomorphites. See the next article.

ANTHROPOMORPHITES, in church-hiftory, a fect of ancient heretics, who taking every thing fpoken of God in Scripture in a literal fenfe, particularly that paffage of Genefis in which it is faid *God made man after his own image*, maintained that God had a human fhape. They are likewife called *Audens*, from Audeus their leader.

ANTHROPOMORPHOUS, fomething that bears the figure of refemblance of a man. Naturalifts give inftances of anthropomorphous plants, anthropomorphous minerals, &c. Thefe generally come under the clafs of what they call *lufus naturæ*, or monfters.

ANTHROPOPATHY, a figure or expreffion by which fome paffion is afcribed to God, which properly belongs only to man.

ANTHROPOPHAGI, (of ανθρωπος a *man*, and φαγω to *eat*), MEN-EATERS. That there have been, in almoft all ages of the world, nations who have followed this barbarious practice, we have a bundance of teftimonies.

The Cyclops, the Leftrygons, and Scylla, are all reprefented in Homer as *anthropophagi*, or man-eaters; and the female phantoms, Circe and the Syrens, firft bewitched with a fhew of pleafure, and then deftroyed. This, like the other parts of Homer's poetry, had a foundation in the manner of the times preceding his own. It was ftill, in many places, the age fpoken of by Orpheus,

> When men devour'd each other like the beafts,
> Gorging on human flefh.——

According to Herodotus, among the Effedonian Scythians, when a man's father died, the neighbours brought feveral beafts, which they killed, mixed up their flefh with that of the deceafed, and made a feaft. Among the Maffagetæ, when any perfon grew old, they killed him and eat his flefh; but if he died of ficknefs, they buried him, efteeming him unhappy. The fame author alfo affures us, that feveral nations in the Indies killed all their old people and the fick, to feed on their flefh: he adds, that perfons in health were fometimes accufed of being fick, to afford a pretence for devouring them. According to Sextus Empiricus, the firft laws that were made, were for the prevention of this barbarious practice, which the Greek writers reprefent as univerfal before the time of Orpheus.

Of the practice of anthropophagy in latter times, we have the teftimonies of all the Romifh miffionaries who have vifited the internal parts of Africa, and even fome parts of Afia. Herrera fpeaks of great markets in China, furnifhed wholly with human flefh, for the better fort of people Marcus Paulus fpeaks of the like in his time, in the kingdom of Concha towards Quinfay, and the ifland of Zapengit; others, of the great Java; Barbofa, of the kingdom of Siam and ifland of Sumatra; others, of the iflands in the Gulf of Bengal, of the country of the Samogitians, &c.

The philofophers Diogenes, Chryfippus, and Zeno, followed by the whole fect of Stoics, affirmed that there was nothing unnatural in the eating of human flefh; and that it was very reafonable to ufe dead bodies for food, rather than to give them a prey to worms and putrefaction. In order to make the trial, however, whether there was any real repugnancy in nature to the feeding of an animal with the flefh of its own fpecies, Leonardus Floroventius fed a hog with hog's flefh, and a dog with dog's flefh; upon which he found the briftes of the hog to fall off, and the dog to become full of ulcers.

When America was difcovered, this practice was found to be almoft univerfal, infomuch that feveral authors have fuppofed it to be occafioned through a want of other food, or through the indolence of the people to feek for it; though others afcribe its origin to a fpirit of revenge.

It appears pretty certain from Dr Hawkefworth's Account of the Voyages to the South Seas, that the inhabitants of the ifland of New Zealand, a country unfurnifhed with the neceffaries of life, eat the bodies of their enemies. It appears alfo to be very probable, that both the wars and anthropophagy of thefe favages take their rife and owe their continuance to irrefiftible neceffity, and the dreadful alternative of deftroying each other by violence or of perifhing by hunger. See vol. iii. p. 447, & feq. and vol. ii. p. 389, &c.

Mr Marfden alfo informs us that this horrible cuftom is practifed by the Battas, a people in the ifland of Sumatra. "They do not eat human flefh (fays he) as a means of fatisfying the cravings of nature, owing to a deficiency of other food; nor is it fought after as a glutonous delicacy, as it would feem among the New Zealanders. The Battas eat it as a fpecies of ceremony; as a mode of fhowing their deteftation of crimes, by an ignominous punifhment; and as a horrid indication of revenge and infult to their unfortunate enemies. The objects of this barbarious repaft are the prifoners taken in war, and offenders convicted and condemned for capital crimes. Perfons of the former defcription may be ranfomed or exchanged, for which they often wait a confiderable time; and the latter fuffer only when their friends cannot redeem them by the cuftomary fine of twenty beenchangs, or eighty dollars.

dollars. These are tried by the people of the tribe where the fact was committee, but cannot be executed till their own particular raja or chief has been acquainted with the sentence; who, when he acknowledges the justice of the intended punishment, sends a cloth to cover the delinquent's head, together with a large dish of salt and lemons. The unhappy object, whether prisoner of war or malefactor, is then tied to a stake: the people assembled throw their lances at him from a certain distance; and when mortally wounded, they run up to him, as if in a transport of passion; cut pieces from the body with their knives; dip them in a dish of salt and lemon juice; slightly broil them over a fire prepared for the purpose; and swallow the morsels with a degree of savage enthusiasm. Sometimes (I presume according to the degree of their animosity and resentment) the whole is devoured; and instances have been known, where, with barbarity still aggravated, they tear the flesh from the carcase with their mouths. To such a depth of depravity may man be plunged, when neither religion nor philosophy enlighten his steps! All that can be said in extenuation of the horror of this diabolical ceremony is, that no view appears to be entertained of torturing the sufferers; of increasing or lengthening out the pangs of death; the whole fury is directed against the corse; warm indeed with the remans of life, but past the sensation of pain. I have found a difference of opinion in regard to their eating the bodies of their enemies slain in battle. Some persons long resident there, and acquainted with their proceeding, assert that it is not customary; but as one or two particular instances have been given by other people, it is just to conclude, that it sometimes takes place, though not generally. It was supposed to be with this intent that raja Neabin maintained a long conflict for the body of Mr Nairne, a most respectable gentleman and valuable servant of the India Company, who fell in an attack upon the campong of that chief, in the year 1775."

It may be said, that whether the dead body of an enemy be eaten or buried, is a matter perfectly indifferent. But whatever the practice of eating human flesh may be in itself, it certainly is relatively, and in its consequences, most pernicious. It manifestly tends to eradicate a principle, which is the chief security of human life, and more frequently restrains the hand of the murderer, than the sense of duty or the dread of punishment. If even this horrid practice originates from hunger, still it must be perpetuated from revenge. Death must lose much of its horror among those who are accustomed to eat the dead; and where there is little horror at the sight of death, there must be less repugnance to murder. See some further observations on this subjects equally just and ingenious, by Dr Hawkesworth, *ut supra*

ANTHROPOPHAGIA, the act or habit of eating human flesh. This is pretended by some to be the effect of a disease, which leads people affected with it to eat every thing alike. Some choose only to consider it as a species of PICA. The annals of Milan furnish an extraordinary instance of anthropophagy. A Milanese woman, named Elizabeth, from a depraved appetite, like what women with child, and those whose menses are obstructed, frequently experience, had an invincible inclination to human flesh, of which she made provision by enticing children into her house, where she killed and salted them; a discovery of which having been made, she was broken on the wheel and burnt in 1519.

ANTHROPOSCOPIA, from ανθρωπος, and σκοπεω, *I consider*, the art of judging or discovering a man's character, disposition, passions, and inclinations, from the lineaments of his body. In which sense, anthroposcopia seems of somewhat greater extent than physiognomy or metoposcopy. Otto has published an Anthroposcopia, *sive judicium hominis de homine ex lineamentis externis*.

ANTHROPOTHYSIA, the inhuman practice of offering human sacrifices. See SACRIFICE.

ANTHUS, in ornithology, a synonime of a species of loxia. See LOXIA.

ANTHYLLIS, KIDNEY-VETCH, or *Lady's-finger*: A genus of the decandria order, belonging to the diadelphia class of plants; and in the natural method ranking under the 32d order, *Papilionaceæ*. The essential characters are: The calyx is ventricose, and the legumen is roundish and covered.

Species. Linnæus enumerates nine species; of which the following seem to be most worthy of attention. 1. The vulneraria, with unequal winged leaves, is a native of Spain and Portugal, as likewise of Wales. It is a biennial plant, having single leaves at bottom, which are oval and hairy; but those which grow out of the stalks are winged, each being composed of two or three pair of lobes terminated by an odd one. The flowers grow collected into heads at the top of the stalks, are of a bright scarlet colour, and make a pretty appearance. It flowers in June and July, and the seeds ripen in October. 2. The montana or herbaceous woundwort, with winged leaves, grows naturally in the mountains in the south of France, and in Italy. It is garnished with winged leaves, which have an equal number of hairy lobes at the extremity of the branches. The flowers are produced in heads, and are of a purple colour and globular form. They appear in June and July, and the seeds ripen in October. 3. The barba jovis, or silver-bush, has its name from the whiteness of its leaves. This is a shrub which often grows to the height of ten or twelve feet, dividing into many lateral branches, garnished with winged leaves composed of an equal number of narrow lobes, which are very white and hairy: the flowers are produced at the extremities of the branches, collected into small heads; these are of a bright yellow colour, and appear in June; sometimes they are succeeded by short woolly pods, containing two or three kidney-shaped seeds: but unless the season proves warm, they do not ripen in this country. 4. The cytisoides, or shrubby woundwort, has long been known in the English gardens. It is a low shrub, seldom rising above two feet high, but sends out many slender branches, garnished with hoary leaves, which are sometimes single, but generally have three oval lobes, the middle being longer than the other two: the flowers are yellow, and come out from the sides of the branches, three or four joined together, having woolly impalements; but these are rarely succeeded by seeds in England.

Culture. The first and second sorts require no particular management further than being kept free from weeds. The third and fourth may be propagated by

Anthypophora || Antichrist.

cuttings planted during any of the summer months; observing to shade and water them till they have taken good root; when they are to be transplanted into pots, and must always be housed in winter.

ANTHYPOPHORA, in rethoric, a figure of speech; being the counter-part of an hypophora. See HYPOPHORA.

ANTI, a Greek preposition, which enters into the composition of several words, both Latin, French, and English, in different senses. Sometimes it signifies *before*, as in anti-chamber; and sometimes *opposite* or *contrary*, as in the names of these medicines, anti-scorbutic, anti-venereal.

ANTI, in matters of literature, is a title given to divers pieces written by way of answer to others, whose names are usually annexed to the anti. See the *Anti* of M. Baillet; and the *Anti-Baillet* of M. Menage: there are also *Anti-Menagiani*, &c. Cæsar the dictator wrote two books by way of answer to what had been objected to him by Cato, which he callled *Anti-Catones;* these are mentioned by Juvenal, Cicero, &c. Vives assures us, he had seen Cæsar's *Anti-Catones* in an ancient library.

ANTIBACCHIUS, in ancient poetry, a foot consisting of three syllables, the two first long, and the last one short: such is the word āmbīrĕ.

ANTIBES, a sea-port town of Provence in France, with a strong castle. Its territory produces excellent fruit; and the town stands opposite to Nice, in the Mediterranean. E. Long. 7. 5. N. Lat. 43. 35.

ANTICHAMBER, an outer chamber for strangers to wait in, till the person to be spoken with is at leisure.

ANTICHORUS, in botany: a genus of the monogynia order, belonging to the octandria class; of which the essential characters are: The calyx is a four-leav'd perianthium: The corolla consists of four expanding petals: The pericarpium is a capsule, above, subulated, with four cells and four valves: The seeds are very numerous. There is but one species, the depressus, a native of Arabia.

ANTICHRIST, among ecclesiastical writers, denotes a great adversary of Christianity, who is to appear upon the earth towards the end of the world.

We have demonstrations, disputations, and proofs, in great order and number, both that the pope is, and that he is not Antichrist.

F. Calmet is very large in describing the father and mother of Antichrist, his tribe and pedigree, his wars and conquests, his atchievements against Gog, Magog, &c.

Some place his capital at Constantinople, others at Jerusalem, others at Moscow, and some few at London; but the generality at Rome, though these last are divided. Grotius and some others suppose Rome Pagan to have been the seat of Antichrist: most of the Lutheran and reformed doctors contend earnestly for Rome Christian under the papal hierarchy. In fact, the point having been maturely debated at the council of Gap, held in 1603, a resolution was taken thereupon, to insert an article in the confession of faith, whereby the pope is formally declared to be Antichrist.—Pope Clement VIII. was stung to the quick with this decision; and even king Kenry IV. of France was not a little mortified, to be thus declared, as he said, an imp of Antichrist.

Antichrist.

M. le Clerc holds, that the rebel Jews and their leader Simon, whose history is given by Josephus, are to be reputed as the true Antichrist. Lightfoot and Vanderhart rather apply this character to the Jewish Sanhedrim. Hippolitus and others held that the devil himself was the true Antichrist; that he was to be incarnate, and make his appearance in human shape before the consummation of all things. Others among the ancients held that Antichrist was to be born of a virgin, by some prolific power imparted to her by the devil. A modern writer* of the female sex, whom many hold for a saint, has improved on this sentiment; maintaining that Antichrist is to be begotten by the devil on the body of a witch, by means of the semen of a man caught in the commission of a certain crime, and conveyed, &c.

* Bayle's Dictionary, voce *Bourignon*.

Hunnius and some authors, to secure Antichrist to the pope (notwithstanding that this latter seemed excluded by not being of the tribe of Dan), have broke in upon the unity of Antichrist, and assert there is to be both an eastern and a western Antichrist.

Father Malvenda, a Jesuit, hath published a large work intitled *Antichristo*, in which this subject is amply discussed. It consists of thirteen books. In the first he relates all the opinions of the Fathers with regard to Antichrist. In the second, he speaks of the times when he shall appear; and shows, that all the fathers who supposed Antichrist to be near at hand, judged the world was near its period. In the third, he discourses of his origin and nation; and shows that he is to be a Jew of the tribe of Dan: this he founds on the authority of the fathers; on the passage in Genesis xlix. 17. *Dan shall be a serpent by the way*, &c.; on that of Jeremy viii. 10. where it is said, *The armies of Dan shall devour the earth;* and on Rev. vii. where St. John enumerating all the tribes of Israel, makes no mention of that of Dan. In the fourth and fifth books, he treats of the signs of Antichrist. In the sixth, of his reign, and wars. In the seventh, of his vices. In the eighth, of his doctrine and miracles. In the ninth, of his persecutions: and in the rest of the coming of Enoch and Elias, the conversion of the Jews, the reign of Jesus Christ, and the death of Antichrist, after he has reigned three years and an half. See also *Lowman on the Revelation*.

How endless are conjectures! Some of the Jews, we are told, actually took Cromwell for the Christ: while some others have laboured to prove him Antichrist himself. Pfaffus assures us he saw a folio book in the Bodleian library, written on purpose to demonstrate this latter position.

Upon the whole, the Antichrist mentioned by the apostle John, 1. Ep. ii. 18. and more particularly described in the book of Revelation, seems evidently to be the same with the *Man of Sin*, &c. characterised by St Paul in his second Epistle to the Thessalonians, ch. ii. And the entire description literally applies to the excesses of papal power. Had the right of private judgment, says an excellent writer, been always adopted and maintained, Antichrist could never have been; and when the sacred right comes to be universally asserted,

serted, and men follow the voice of their own reason and consciences, Antichrist can be no more.

ANTICHRISTIANISM, a state or quality in persons or principles, which denominates them antichristian, or opposite to the kingdom of Christ.

M. Jurieu takes the idea of the unity of the church to have been the source of *Antichristianism*. Had not mankind been infatuated with this, they would never have stood in such awe of the anathemas of Rome. It is on this the popes erected their monarchial power.

ANTICHRISTIANS properly denote the followers or worshippers of Antichrist.

ANTICHRISTIANS are more particularly understood of those who set up or believe a false Christ, or Messiah.

ANTICHTHONES, in ancient geography, an appellation given to the inhabitants of opposite hemispheres.

ANTICOR, or ANTICOEUR, among farriers, an inflammation in a horse's throat, being the same with the quinzy in mankind. See FARRIERY, xxxvii. 2.

ANTICOSTE, a barren island lying in the mouth of the river St Laurence, in North America. W. Long. 64. 16. N. Lat. from 49 to 53.

ANTICYRA (anc. geog.), a town in Phocis, on the Corinthian bay, opposite to Cirrha, lying to the west on the same bay. The Phoceans seizing the temple of Apollo at Delphi, a war, called the *sacred*, commenced, and lasted ten years; when Philip, father of Alexander the great, avenged the god, by destroying many of the cities of the pillagers. Anticyra was one of the number. It was again taken and subverted by Atilius a Roman general in the war with the Macedonians. It afterwards became famous for its hellebore. That drug was the root of a plant, the chief produce of the rocky mountains above the city, and of two kinds; the black, which had a purgative quality; and the white, which was an emetic. Sick persons resorted to Anticyra to take the medicine, which was prepared there by a peculiar and very excellent recipe: Hence the adage, *Naviget Anticyram*, (Hor.) By the port in the second century was a temple of Neptune, not large, built with selected stones, and the inside white-washed; the statue of brass. The agora or market-place was adorned with images of the same metal; and above it was a well with a spring, sheltered from the sun by a roof supported by columns. A little higher was a monument formed with such stones as occurred, and designed, it is said, for the sons of Iphitus. One of these, Schedius, was killed by Hector, while fighting for the body of Patroclus, but his bones were transported to Anticyra; where his brother died after his return from Troy. About two stadia or a quarter of a mile distant was a high rock, a portion of the mountain, on which a temple of Diana stood, the image bigger than a large woman, and made by Praxiteles. The walls and other edifices at Anticyra were probably erected like the temple of Neptune, with stones or pebbles. The site is now called *Asprospitia*, or *The White Houses*; and some traces of the buildings from which it was so named remain. The port is land-locked, and frequented by vessels for corn. Some paces up from the sea is a fountain.

ANTIDESMA, in botany, a genus of the dioecia order, belonging to the pentandria class of plants. The *calyx* of the male is five-leav'd; there is no corolla; the *antheræ* are bifid: The female *calyx* is five-leav'd; the corolla is wanting; the *stigmata* are five; the *berry* is cylindric and one-seeded. There is but one species, the alexiteria, a native of India.

ANTIDICOMARIANITES, ancient heretics, who pretended that the holy virgin did not preserve a perpetual virginity, but that she had several children by Joseph after our Saviour's birth.—Their opinion was grounded on some expressions of our Saviour, wherein he mentions his brothers and his sisters; and of St Matthew, where he says, that Joseph knew not Mary till she brought forth her first-born son. The Antidicomarianites were the disciples of Helvidius and Jovinian, who appeared in Rome towards the close of the fourth century.

ANTIDORON, in ecclesiastical writers, a name given by the Greeks to the consecrated bread, out of which the middle part, marked with the cross, wherein the consecration resides, being taken away by the priest, the remainder is distributed after mass to the poor. On the sides of the antidoron are impressed the words *Jesus Christus vicit*. The word is formed from δωρον, *donum*, "a gift," as being given away *loco muneris*, or in charity. The antidoron is also called *panis præsanctificatus*. Some suppose the antidoron to be distributed in lieu of the sacrament, to such as were prevented from attending in person at the celebration; and thence derived the origin of the word, the eucharist being denominated *doron*, "gift," by way eminence.

ANTIDOSIS, in antiquity, denotes an exchange of estates, practised by the Greeks on certain occasions with peculiar ceremonies, and first instituted by Solon.

When a person was nominated to an office, the expence of which he was not able to support, he had recourse to the antidosis; that is, he was to seek some oother citizen of better substance than himself, who was free from this, and other offices; in which case the former was excused. In case the person thus substituted denied himself to be the richest, they were to exchange estates after this manner; the doors of their houses were close shut up and sealed, that nothing might be conveyed away; then both took an oath to make a faithful discovery of all their effects, except what lay in the silver-mines, which by the laws was excused from all imposts; accordingly, within three days, a full discovery and exchange of estates was made.

ANTIDOTE, among physicians, a remedy taken to prevent, or to cure, the effects of poison, &c.

ANTIENT. See ANCIENT.

ANTIGONEA, or ANTIGONIA (anc. geog.), a town of Bithynia, so called from Antigonus, the son of Philip, and afterwards called *Nicæa* (Strabo, Stephanus.) Another of Epirus, to the north of the Montes Ceraunii, opposite to the city of Oricum (Polybius Ptolemy.) A third of Arcadia, namely *Mantinea*, so called in honour of king Antigonus (Plutarch, Pausanias.) A fourth in Macedonia, in the territory of Mygdonia (Pliny, Ptolemy.) A fifth in the territory of Chalcidice, in Macedonia, on the east side of the Sinus Thermaicus (Livy.) A sixth of Syria, built by Antigonus, not far from Antioch, on the Orontes (Stephanus); but soon after destroyed by

Seleucus,

Seleucus, who removed the inhabitants to Seleucia, a town built by him (Diodorus Siculus.) A seventh of Troas, called Alexandrea in Pliny's time.

ANTIGONUS, one of Alexander's commanders, to whom Asia fell. He conquered Eumenes, and expelled Seleucus out of Syria; who flying to Ptolemy Lagus in Egypt, a bloody war commenced betwixt him, Cassander, and Antigonus, wherein, by the help of his son Demetrius, Antigonus prevailed, and built the city Antigonia, anno Romæ 448. Afterward Cassander, Seleucus, and Lysimachus, uniting against him, routed him, in league with king Pyrrhus, and slew him near Epirus, 301 years before Christ.

ANTIGONUS, king of the Jews, was the son of Aristobulus. He entered into an alliance with the king of the Parthians, and besieged Jerusalem. He cut off his uncle Hircanus's ears, to incapacitate him for the high-priesthood, and put Josephus, Herod's brother, to death. At length, Herod took him and sent him to M. Anthony; who, to gratify Herod, cut off his head, and thereby extinguished the Asmoneans, who had reigned 126 years. This happened 36 years before Christ.

ANTIGRAPHUS, in antiquity, an officer of Athens, who kept a counterpart of the apodecti, or chief treasurer's account, to prevent mistakes, and keep them from being falsified.

ANTIGRAPUS is also used, in middle-age writers, for a secretary or chancellor. He is thus called, according to the old glossarists, on account of his writing answers to the letters sent to his master. The antigraphus is sometimes also called *archigraphus*; and his dignity *antigraphia* or *archigraphia*.

ANTIGRAPHUS is also used in Isidorus for one of the notes of sentences, which is placed with a dot to denote a diversity of sense in translations.

ANTIGRAPHUS is also applied in ecclesiastical writers to an abbreviator of the papal letters. In which sense the word is used by pope Gregory the Great in his register. Of late days the office of antigraphus consists in making minutes of bulls from the petitions agreed to by his holiness, and renewing the bulls after engrossing.

ANTIGUA, one of the Antilles or Caribbee islands, situated 20 leagues east of St Christopher's, in W. Long. 62. 5. and N. Lat. 17. 30. It is about 50 miles in circumference, and is reckoned the largest of all the British leeward islands.

This island having no rivers, and but few springs, or such as are brackish, the inhabitants are obliged to preserve the rain-water in cisterns. The air here is not so wholesome as in the neighbouring islands, and it is more subject to hurricanes; but it has excellent harbours, particularly English Harbour, which is capable of receiving the largest man of war in the navy. Here is also a dock-yard, supplied with all stores and conveniences for repairing and careening ships. The principal trade, however, is carried on in the harbour of St John's, the capital, situated in the north-west part of the island, and which has water sufficiently deep for merchant vessels. The town of St John's was once in a very flourishing condition, as may be judged by the loss sustained at the late fire, which was computed at the amazing sum of L.400,000.

This island was first attempted to be settled by Sir Thomas Warner, about the same time with St Christopher's and Nevis: but no establishment then took place. It was afterwards granted by Charles II. to Lord Willoughby, then governor of Barbadoes, who settled a colony upon it in the space of a few years. In a short time, but by what means is not evident, it became again the public property. It raises at present about 16,000 hogsheads of sugar, which was at first of a very bad quality, unfit for the English market; but the planters have greatly improved their staple since, and it is now as good as in any of the other islands. It has continued unmolested in all the late wars with France. The number of white inhabitants is reckoned about 10,000. It is divided into five parishes; that of St John's-town, which is reckoned the capital of the north-west part, and consists of above 200 houses; those of Falmouth, Porham, and Bridgetown, on the south-side; and St Peters's, which is no town, but lies almost in the middle of the island.

ANTIGUGLER, is a crooked tube of metal, so bent, as easily to be introduced into the necks of bottles, and used in decanting liquors, without disturbing them. For this purpose the bottle should be a little inclined, and about half a spoonful of the liquor poured out, so as to admit an equal quantity of air; let one end of the bent tube be stopped with the finger, whilst the other is thrust into the body of the liquor near to the bubble of air already admitted. When the finger is taken off, the bottle will have vent, and the liquor will run out steadily and undisturbed.

ANTIHECTICS, in pharmacy, medicines good in hectical disorders.

ANTIHECTICUM POTERII, the name of a medicine formerly much celebrated, but now laid aside in common practice.

ANTILIBANUS (anc. geog.), a mountain of Cœlosyria, which bounds it on the south, running parallel with Libanus: they both begin a little above the sea, Libanus near Tripolis, Antilibanus at Sidon; and both terminate near the mountains of Arabia, which run to the north of Damascus, and the mountains of Traconitis, and there end in other mountains (Strabo.) The Scripture making no distinction between Libanus and Antilibanus, calls them by the common name *Lebanon*.

ANTILLES, the French name for the CARIBEE islands.

ANTILOGARITHM, the complement of the logarithm of a sine, tangent, or secant; or the difference of that logarithm from the logarithm of 90 degrees.

ANTILOGY, in matters of literature, an inconsistency between two or more passages of the same book.

ANTILOPE. See CAPRA.

ANTIMENSIUM, a kind of consecrated tablecloth, occasionally used in the Greek church, in places where there is no proper altar. F. Goar observes, that in regard the Greeks had but few consecrated churches, and that consecrated altars are not things easy to be removed; that church has, for many ages, made use of certain consecrated stuffs or linens, called *antimensia*, to serve the purposes thereof.

ANTIMENSIUM, in the Greek church, answers to the *altare portabile*, or portable altar, in the Latin church. They are both only of late invention, though

Habertus would have them as old as St Basil. But Durant and Bona do not pretend to find them in any author before the time of Bede and Charlemagne.

Antimensia is also applied to other tables, used in offices of religion, besides those whereon the eucharist is administered: such, *e. g.* are those whereon the host is exposed, &c. The origin of the Antimensia is described by Meursius; when the bishop had consecrated a church, the cloth which had been spread on the ground, and over the communion table, was torn in pieces, and distributed among the priests, who carried each a fragment away, to serve to cover the tables in their churches and chapels. Not that it was necessary that such cloths should be laid on all tables; but only on those which either were not consecrated, or at least whose consecration was doubted of.

ANTIMERIA, in grammar, a figure whereby one part of speech is used for another: e. g. *velle suam cuique est*, for *voluntas sua cuique est*; also, *populus late rex*, for *populus late regnans.*

Antimeria, in a more restrained sense, is a figure where the noun is repeated instead of the pronoun. The antimeria is frequent in the Hebrew, and is sometimes retained in our version of the Old Testament accordingly: e. g. *Hear my voice, ye wives of Lamech*, for *my wives*, Gen. iv. 23.

ANTIMETABOLE, in rhetoric, a figure which sets two things in opposition to each other. The word is Greek, compounded of αντι, *against*, and μεταϐολη from μεταϐαλλω, I *shift* or *transfer*; *i. e.* a shifting, or setting two things over-against each other. This figure is twice exemplified in an apophthegm of Musonius: which, on account of its excellence, is called *aureum monitum*, the golden maxim or precept.

Αν τι πραξης καλον μετα πονȣ, ὁ μεν πονος οιχεται, το δε καλον μενει.

Αν τι ποιησης αισχρον μετα ηδονης, το μεν ηδυ οιχεται, το δε αισχρον μενει.

In English thus:

"Allowing the performance of an honourable action to be attended with labour; the labour is soon over, but the honour immortal: whereas, should even pleasure wait on the commission of what is dishonourable, the pleasure is soon gone, but the dishonour eternal."

ANTIMETATHESIS, in rhetoric, is the inversion of the parts or members of an Antithesis. Such is that of Cicero, in Verrem, lib. iv. cap. 52. "Compare this peace with that war; the arrival of this governor with the victory of that general; his profligate troops with the invincible army ot the other; the luxury of the former with the temperance of the latter: you will say, that Syracuse was founded by him who took it; and taken by him, who held it when founded."

ATIMONARCHICAL, an appellation given to whatever opposes monarchical government.

ANTIMONIALS, in medicine, preparations of antimony. See Pharmacy.

ANTIMONY, a blackish mineral substance, staining the hands, full of long, shining, needle-like striæ, hard, brittle, and considerably heavy. It is found in different parts of Europe, as Bohemia, Saxony, Transylvania, Hungary, France, and England; commonly in mines by itself, intermixed with earth and stony matters. Sometimes it is blended with the richer ores of silver, and renders the extraction of that metal difficult by volatillizing a part of the silver, or, in the language of the miners, *robbing the ore*. See Metallurgy for the different operations.

Antimony is the *stibium* of the ancients; by the Greeks called στιμμι. The reason of its modern denomination, *antimony*, is usually referred to Basil Valentine, a German monk, who, as the tradition relates, having thrown some of it to the hogs, observed, that, after purging them violently, they immediately grew fat upon it. This made him think, that, by giving his fellow-monks a like dose, they would be the better for it. The experiment, however, succeeded so ill, that they all died of it; and the medicine thenceforwards was called *antimony*, q. d. *anti-monk*.

Uses. Antimony at first was of service only in the composition of paint. Scripture describes it to us as a sort of paint, with which the women blackened their eye-brows. Jezebel, understanding that Jehu was to enter Samaria, painted her eyes with antimony; or, according to the Hebrew, "put her eyes in antimony." As large black eyes were thought the finest, they of both sexes, who were careful of their beauty, rubbed their eyes, eye-lids, and round the eyes, with a needle dipped in a box of paint made of antimony, with a design of blackening them.—At this day, the women of Syria, Arabia, and Babylonia, anoint and blacken themselves about the eyes; and both men and women put black upon their eyes in the desert, to preserve them from the heat of the sun and the piercing of its rays. Mr Darvieux tells us, that the Arabian women border their eyes with a black colour made of tutty, which the Arabians call *rehel*. They draw a line of the kind of blacking without the corner of their eyes, to make them appear larger. Isaiah, in his enumeration of the several ornaments belonging to the daughters of Sion, has not forgot the needles which they made use of in painting their eyes and eyelids. Nor has this practice escaped the lash of Juvenal:

Ille supercilium madida fuligine tinctum
Obliqua producit acu, pingitque trementes
Attollens oculos.

Ezekiel, discovering the irregularities of the Jewish nation under the idea of a debauched woman, says, that she bathed and perfumed herself, and that she anointed her eyes with antimony. Job shows sufficiently how much antimony was in esteem, by calling one of his daughters a vessel of antimony, or a box to put paint in, *cornu stibii*. The author of the Book of Enoch says, that before the deluge the angel Azleel taught young women the art of painting themselves.

Tertullian and St Cyprian have declaimed very warmly against this custom of painting their eyes and eye-brows, which was much practised in Afric even by the men: *Inunge oculos tuos non stibio diaboli, sed collyrio Christi*, says St Cyprian. Pliny, speaking of the Roman ladies, says, that they painted their very eyes: *Tanta est decoris affectatio, ut tingantur oculi quoque.* Sardanapalus painted his eyes and eye-brows. Josephus reproaches the seditious with the same, who assumed the name of zealots, and made themselves masters of the temple of Jerusalem.

The modern uses of antimony are very numerous and important. It is a common ingredient in specula or burning concaves, serving to give the composition a finer texture. It makes a part in bell metal, and renders the sound more clear. It is mingled with tin, to make it more hard, white, and sounding; and with lead, in the casting of printers letters, to render them more smooth and firm. It is also a general help in the melting of metals, and especially in the casting of cannon balls. It is likewise made use of for purifying and heightening the colour of gold. See CHEMISTRY, GOLD, PURIFICATION, &c.

For a long time this mineral was esteemed poisonous. In 1566, its use was prohibited in France by an edict of parliament; and in 1609, one Besnier was expelled the faculty for having given it. The edict was repealed in 1650; antimony having a few years before been received into the number of purgatives. In 1668, a new edict came forth, forbidding its use by any but doctors of the faculty.—It is now universally allowed, that pure antimony in its crude state has no noxious quality; and that though many of its preparations are most virulently emetic and cathartic, yet, by a slight alteration or addition, they lose their virulence, and become mild in their operation. See CHEMISTRY and PHARMACY.

The virtues of antimony in the diseases of animals are greatly extolled. Pigs that have the measles are at all times recovered by it, which proves it a great purifier of the blood. Horses who have running heels that cannot be cured by the common methods used by the farriers, will generally be cured by this medicine in a little time. The manner of using it is this: Mix one dram with every feeding of oats which the horse has in a morning. It is best put together in one place, buried under a few oats; and the horse's head being with-held a little, and then let go just against that place, he will take it all in at a mouthful. Some horses do not dislike it; others obstinately refuse it, but to these it may easily be given in balls. The virtues of this drug in fattening of cattle has been thought imaginary, but experiment proves it to be a real truth. A horse that is lean and scabby, and not to be fatted by any other means, will become fat on taking a dose of antimony every morning for two months together. A boar fed for brawn, and having an ounce of antimony given him every morning, will become fat a fortnight sooner than others put into the stye at the same time, and fed in the same manner, but without the antimony.

ANTINOE. See ENFINE'.

ANTINOEIA, in antiquity, annual sacrifices, and quinquennial games, in memory of Antinous the Bithynian. They were instituted at the command of Adrian the Roman emperor, at Mantinea in Arcadia, where Antinous was honoured with a temple and divine worship.

ANTINOMIANS, in ecclesiastical history, certain heretics who maintain the law of no use or obligation under the gospel-dispensation, or who hold doctrines that clearly supercede the necessity of good works and a virtuous life. The Antinomians took their origin from John Agricola about the year 1538; who taught, that the law is no ways necessary under the gospel; that good works do not promote our salvation, nor ill ones hinder it; that repentance is not to be preached from the decalogue, but only from the gospel.

This sect sprung up in England during the protectorate of Oliver Cromwell, and extended their system of libertinism much farther than Agricola the disciple of Luther. Some of their teachers expressly maintained, that as the elect cannot fall from grace, nor forfeit the Divine favour, the wicked actions they commit are not really sinful, nor are to be considered as instances of their violation of the divine law; and that consequently they have no occasion either to confess their sins, or to break them off by repentance. According to them, it is one of the essential and distinctive characters of the elect, that they cannot do any thing which is either displeasing to God or prohibited by the law.—Luther, Rutherford, Schlusselburg, Sedgwick, Gataker, Witsius, Bull, Williams, &c. have written refutations; Crisp, Richardson, Saltmarsh, &c. defences, of the Antinomians; Wigandus, a comparison between ancient and modern Antinomians.

The doctrine of Agricola was in itself obscure, and perhaps represented worse than it really was by Luther, who wrote with acrimony against him, and first styled him and his followers *Antinomians*. Agricola stood on his own defence, and complained that opinions were imputed to him which he did not hold. Nicholas Amsdorf fell under the same odious name and imputation, and seems to have been treated more unfairly than even Agricola himself. It is rather hard to charge upon a man all the opinions that may be inferred from things that have hastily dropped from him, when he himself disavows such inferences.

ANTINOUS, the favourite of Adrian, was born at Bithynus in Bithynia His beauty engaged the heart of Adrian in such a manner, that there never was a more boundless and extravagant passion than that of this emperor toward this youth. After his death, the emperor ordered divine honours to be paid him; and he also erected a city of his name. See ENFINE'.

ANTIOCH, a city of Syria in Asia, situated on the river Orontes, in E. Long. 37. 5. N. Lat. 36. 20. It was built by Seleucus Nicator, founder of the Syro-Macedonian empire, who made it his capital. It stood on the above-mentioned river, about 20 miles from the place where it empties itself into the Mediterranean; being equally distant from Constantinople and Alexandria in Egypt, that is, about 700 miles from each. Seleucus called it *Antioch*, from his fathers name, according to some; or from that of his son, according to others. He built 16 other cities bearing the same name; of which one, situated in Pisidia, is probably that where the name of *Christians* was first given to the followers of Jesus Christ. But that situated on the Orontes, by far eclipsed, not only all the others of this name, but all the cities built by Seleucus. Antigonus, not long before, had founded a city in that neighbourhood, which from his own name he had called *Antigonia*, and designed it for the capital of his empire; but it was rased to the ground by Seleucus, who employed the materials in building his metropolis, and also transplanted the inhabitants thither.

The city of Antioch was afterwards known by the name of *Tetrapolis*, being divided as it were into four cities, each of them being surrounded with its proper wall.

Antioch. wall, besides a common one which inclosed them all. The first of these cities was built by Seleucus Nicator, as already mentioned; the second by those who flocked thither on its being made the capital of the Syro-Macedonian empire; the third by Seleucus Callinicus; and the fourth by Antiochus Epiphanes.—About four or five miles distant, stood a place called *Daphne*, which was nevertheless reckoned a suburb of Antioch. Here Seleucus planted a grove, and in the middle of it built a temple which he consecrated to Apollo and Diana, making the whole an asylum. To this place the inhabitants of Antioch resorted for their pleasures and diversions; whereby it became at last so infamous, that, "to live after the manner of Daphne" was used as a proverb to express the most voluptuous and dissolute way of living. Here Lucius Verus, the colleague of M. Aurelius, chose to take up his residence, instead of marching against the Parthians; while his general Cassius forbade by proclamation any of his soldiers to enter or even go near the place. In short, so remarkable was Daphne of old, that the metropolis itself was distinguished by it, and called *Antioch near Daphne*.

Though Antioch continued to be, as Pliny calls it, the queen of the East, for near 1600 years; yet scarce any city mentioned in history hath undergone such calamities, both from the attacks of its enemies, and its being naturally subjected to earthquakes.—The first disaster mentioned in history which befel the Antiochians happened about 145 years before Christ. Being at that time very much disaffected to the person and government of Demetrius their king, they were continually raising tumults and seditions; insomuch that he found himself at last obliged to solicit assistance from the Jews; and was furnished by Jonathan, one of the Maccabees, with 3000 men: by which reinforcement, believing himself sufficiently strong to reduce the mutineers by force, he ordered them immediately to deliver up their arms. This unexpected order caused a great uproar in the city. The inhabitants ran to arms, and invested the king's palace, to the number of 120,000, with a design to put him to death. All the Jews hastened to his relief, fell upon the rebels, killed 100,000 of them, and set fire to the city. On the destruction of the Syrian empire by the Romans, Antioch submitted to them as well as the other cities of that kingdom, and continued for a long time under their dominion. About the year 115, in the reign of the emperor Trajan, it was almost entirely ruined by one of the most dreadful earthquakes mentioned in history. Trajan himself happened to be there at that time, being returned from an expedition against the Parthians; so that the city was then full of troops, and strangers come from all quarters either out of curiosity or upon business and embassies: the calamity was by this means felt almost in every province of the Roman empire. The earthquake was preceded by violent claps of thunder, unusual winds, and a dreadful noise under ground. The shock was so terrible, that great numbers of houses were overturned, and others tossed to and fro like a ship at sea. Those who happened to be in their houses were for the most part buried under their ruins: those who were walking in the streets or in the squares, were, by the violence of the shock, dashed against each other, and most of them either killed of dangerously wounded.—This earthquake continued, with some small intermission, for many days and nights; so that vast numbers perished. The most violent shock, according to the Acts of St Ignatius, was on a Sunday, December 23. By this Trajan was much hurt, but escaped through a window. Dio Cassius pretends, that he was taken out of the window by one who exceded the human size in tallness. The same historian adds, that mount Lison, which stood at a small distance from the city, bowed with its head and threatened to fall down upon it; that other mountains fell; that new rivers appeared, and others that had flowed before forsook their course and vanished. When the earthquake ceased, a woman was heard crying under the ruins; which being immediately removed, she was found with a living child in her arms. Search was made for others; but none was found alive, except one child, which continued sucking its dead mother.

No doubt, Trajan, who was an eye-witness of this terrible calamity, would contribute largely towards the re-establishment of Antioch in its ancient splendor. Its good fortune, however, did not continue long; for in 155, it was almost entirely burnt by accidental fire; when it was again restored by Antoninus Pius. In 176 or 177, the inhabitants having sided with Cassius, the abovementioned Roman general, who had revolted from M. Aurelius, that emperor published a severe edict against them, deprived them of all their privileges, suppressed their public assemblies, and took from them the shows and spectacles to which they were greatly addicted: but his anger being soon appeased, he restored them to their former condition, and even condescended to visit their city. In 194, having sided with Niger against Severus, the latter deprived them of all their privileges, and subjected Antioch as a mere village to Laodicea; but, however, pardoned them the next year at the intreaties of his eldest son, then a child.

When the power of the Roman empire began to decline, Antioch became the bone of contention between them and the eastern nations; and accordingly, on the breaking out of a Persian war, it was almost always sure to suffer. In 242, it was taken and plundered by Sapor; and, though he was defeated by Gordian, it underwent the same misfortune in the time of Valerian, about 18 years after; and after the defeat and captivity of Valerian, being taken by the Persian monarch a third time, he not only plundered it, but levelled all the public buildings with the ground. The Persians, however, being soon driven out, this unfortunate city continued free from any remarkable calamity till about the time of the division of the Roman empire by Constantine in 331. It was then afflicted with so grievous a famine, that a bushel of wheat was sold for 400 pieces of silver. During this grievous distress, Constantine sent to the bishop 30,000 bushels of corn; besides an incredible quantity of all kinds of provisions, to be distributed among the ecclesiastics, widows, orphans, &c. In the year 347, Constantine II. caused an harbour to be made at Seleucia, for the convenience of Antioch. This was effected at an immense expence, the mouth of the Orontes, where the port was made, being full of sands and rocks. When the emperor Julian set out on his expedition against the Persians, he made a long stay at Antioch; during which time, many of the Roman provinces were afflicted with a famine, but which raged more violently at Antioch than in other places.

The

Antioch. The ecclesiastical writers of those times say, that this famine followed Julian from place to place; and as he continued longer at Antioch than any other city, it raged more violently there than any where else. To remedy this evil, Julian fixed the prices of corn; by which means the famine was greatly increased, the merchants conveying their corn privately to other places, so that this metropolis was reduced to a most deplorable situation. In 381, in the reign of Theodosius the Great, Antioch was again visited by a famine, accompanied by a grievous plague. The latter soon ceased: but, the famine still continuing, the bishop, Libanius, applied to Icarius, count of the East, requesting him by some means or other to relieve the poor, who had flocked from all parts to the metropolis, and were daily perishing in great numbers: but to this Icarius gave no other answer, than that they were abhorred and justly punished by the gods. This inhuman answer raised great disturbances; which, however, were terminated without bloodshed. In 387, Theodosius finding his exchequer quite drained, and being obliged to be at an extraordinary expence in celebrating the fifth year of the reign of his son Arcadius, and the tenth of his own, an extraordinary tax was laid upon all the people in the empire. Most of the cities submitted willingly to this; but the people of Antioch, complaining of it as an unreasonable oppression, crowded to the house of Flavianus their bishop, as soon as the edict was published, to implore his protection. Being unable to find him, they returned to the forum; and would have torn the governor in pieces, had not the officers who attended him kept back with great difficulty the enraged multitude, till he made his escape. Upon this, they broke some of the emperor's statues, and dragged others through the city, uttering the most injurious and abusive expressions against him and his whole family. They were however, dispersed by a body of archers, who, by wounding only two of the rabble, struck terror into all the rest. The governor proceeded against the offenders with the utmost cruelty; exposing some to wild beasts in the theatre, and burning others alive. He did not spare even the children, who had insulted the emperor's statues; and caused several persons to be executed, who had been only spectators of the disorder. In the mean time, a report was spread, that a body of troops was at hand, with orders to plunder the city, and put all to the sword, without distinction of sex or age; upon which the citizens abandoned their dwellings in the utmost terror and confusion, retiring to the neighbouring mountains with their wives and families. As the report proved groundless, some of them returned; but the greater part, dreading the cruelty of the governor, and the displeasure of the emperor, continued in their retreats. To those who returned, St Chrysostom preached some homilies, which have reached our times, and are greatly admired; and which are said by St Chrysostom himself, as well as some cotemporary writers, to have had a considerable effect in reforming the lives of this licentious and dissolute people. On hearing the news of this tumult, Theodosius was so much enraged, that he commanded the city to be destroyed, and its inhabitants to be put to the sword without distinction; but this order was revoked before it could be put into execution, and he contented himself with a punishment similar to that inflicted by Severus above-mentioned. He appointed judges to punish the offenders; who proceeded with such severity, and condemned such numbers, that the city was thrown into the utmost consternation. On this occasion, St Chrysostom and the hermits, who were very numerous in the neighbourhood, exerted all their eloquence in behalf of the unhappy people, and obtained a respite for those who had been condemned. They next proceeded to draw up a memorial to the emperor in favour of the citizens in general; and being joined by Flavianus, at last obtained a general pardon, and had the city restored to all its former privileges.

In the year 458, Antioch was almost entirely ruined by an earthquake, which happened on the 14th of September; scarce a single house being left standing in the most beautiful quarter of the city. The like misfortune it experienced in 525, during the reign of the emperor Justin; and 15 years after, being taken by Cosrhoes king of Persia, that insulting and haughty monarch gave it up to his soldiers, who put all they met to the sword. The king himself seized on all the gold and silver vessels belonging to the great church; and caused all the valuable statues, pictures, &c. to be taken down and conveyed to Persia, while his soldiers carried off every thing else. The city being thus completely plundered, Cosrhoes ordered his men to set fire to it; which was accordingly done so effectually, that none of the buildings even without the walls escaped. Such of the inhabitants as escaped slaughter were carried into Persia, and sold as slaves.

Notwithstanding so many and so great calamities, the city of Antioch soon recovered its wonted splendor; but in a short time underwent its usual fate, being almost entirely destroyed by an earthquake in 587, by which 30,000 persons lost their lives. In 634, it fell into the hands of the Saracens, who kept possession of it till the year 858, when it was surprised by one Burtzas, and again annexed to the Roman empire. The Romans continued masters of it for some time, till the civil dissentions in the empire gave the Turks an opportunity of seizing upon it as well as the whole kingdom of Syria. From them it was again taken by the Crusaders in 1098. In 1262, it was taken by Bibaris sultan of Egypt, who put a final period to its glory.

Antioch is now no more than a ruinous town, whose houses, built with mud and straw, and narrow and miry streets, exhibit every appearance of misery and wretchedness. These houses are situated on the southern bank of the Orontes, at the extremity of an old decayed bridge: they are covered to the south by a mountain; upon the slope of which is a wall, built by the Crusaders. The distance between the present town and this mountain may be about 400 yards, which space is occupied by gardens and heaps of rubbish, but presents nothing interesting.

Notwithstanding the unpolished manners of its inhabitants, Antioch was better calculated than Aleppo to be the emporium of the Europeans. By clearing the mouth of the Orontes, which is six leagues lower down, boats might have been towed up that river, though they could not have sailed up, as Pococke has asserted; its current is too rapid. The natives, who never knew the name Orontes, call it, on account of the swiftness of its stream, *El-aasi*, that is, the rebel. Its breadth, at Antioch, is about forty paces. Seven

 leagues

leagues above that town it passes by a lake abounding in fish, and especially in eels. A great quantity of these are salted every year, but not sufficient for the numerous fasts of the Greek Christians. It is to be remembered, we no longer hear at Antioch, either of the Grove, or Daphne, or of the voluptuous scenes of which it was the theatre.

The plain of Antioch, though the soil of it is excellent, is uncultivated, and abandoned to the Turcomans; but the hills on the side of the Orontes, particularly opposite Serkin, abound in plantations of figs and olives, vines, and mulberry trees, which, a thing uncommon in Turkey, are planted in quincunx, and exhibit a landscape worthy our finest provinces.

Seleucus Nicator, who founded Antioch, built also at the mouth of the Orontes, on the northern bank, a large and well fortified city, which bore his name, but of which at present not a single habitation remains: nothing is to be seen but heaps of rubbish, and works in the adjacent rock, which prove that this was once a place of very considerable importance. In the sea also may be perceived the traces of two piers, which are indications of an ancient port, now choaked up. The inhabitants of the country go thither to fish, and call the name of the place *Souaidia*.

ANTIOCHETTA, a town of Turkey, in Asia, in Carimania, with a bishop's see, over-against the island of Cyprus. E. Long. 32. 15. N. Lat. 36. 42.

ANTIOCHIA (anc. geog.), a town of Assyria, situated between the rivers Tigris and Tornadotus (Pliny).—Another of Caria, on the Meander; called also *Pythopolis*, *Athymbra*, and *Nyssa*, or *Nysa* (Stephanus): but Strabo says, that Nysa was near Tralles.—A third of Cilicia Trachea, on mount Cragus (Ptolemy).—A fourth, called *Epidaphnes*, the capital of Syria, distinguished from cities of the same name, either by its situation on the Orontes, by which it was divided, or by its proximity to Daphne (See ANTIOCH).—A fifth Antiochia, a town of Comagene, on the Euphrates (Pliny).—A sixth, of Lydia, *Tralles* so called (Pliny).—A seventh, of Margiana, (Strabo, Pliny, Ptolemy), on the river Margus, taking its name from Antiochus, son of Seleucus, who rebuilt it, and walled it round, being before called *Alexandria*, from Alexander the founder, and surnamed Syria; in compass seventy stadia: whither Orodes carried the Romans, after the defeat of Crassus (Pliny)—An eighth, in Mesopotamia, on the lake Calirrhoe, the old name of Edessa (Pliny).—A ninth Antiochia, on the river Mygdonius, in Mesopotamia, situate at the foot of mount Masius, and is the same with Nisibis (Strabo, Plutarch). It was the bulwark and frontier town of the Romans against the Parthians and Persians, till given up to the Persians, by Jovinian, by an ignominious peace [Ammian, Eutropius).—A tenth Antiochia, was that situate in the north of Pisidia (Luke, Ptolemy, Strabo): it was a Roman colony, with the appellation, *Cæsarea*. There is an Antiochia at mount Taurus, mentioned by Ptolemy, but by no other author.

ANTIOCHIAN SECT or *Academy*, a name given to the fifth academy, or branch of academies. It took the denomination from its being founded by Antiochus, a philosopher contemporary with Cicero.—The Antiochian academy succeeded the Philonian. As to point of doctrine, the philosophers of this sect appear to have restored that of the ancient academy, except that in the article of the criterion of truth. Antiochus was really a stoic, and only nominally an academic.

ANTIOCHIAN Epocha, a method of computing time from the proclamation of liberty granted the city of Antioch, about the time of the battle of Pharsalia.

ANTIOCHUS, the name of several kings of SYRIA. See that article.

ANTIOCHUS of *Ascalon*, a celebrated philosopher, the disciple of Philo of Larissa, the master of Cicero, and the friend of Lucullus and Brutus. He was founder of a fifth academy; but, instead of attacking other sects, he set himself down to reconcile them together, particularly the sect of the stoics with that of the ancient academy.

ANTIOPE, in fabulous history, the wife of Lycus, king of Thebes, who, being deflowered by Jupiter in the form of a satyr, brought for Amphion and Zethus.—Another Antiope was queen of the Amazons; and, with the assistance of the Scythians, invaded the Athenians; but was vanquished by Theseus.

ANTIPÆDOBAPTISTS, (derived from ἀντι *against*, παις, παιδος, *child*, and βαπτιζω, *baptize*, whence βαπτιστης), is a distinguishing denomination given to those who object to the baptism of infants; because they say, infants are incapable of being instructed, and of making that profession of faith which intitles them to this ordinance and an admission into church communion. See ANABAPTISTS and BAPTISTS.

ANTIPAROS, an island in the Archipelago, opposite to Paros, from which it is separated by a strait about seven miles over. It is the *Olearos*, or *Oliaros*, mentioned by Strabo, Pliny, Virgil, Ovid, &c.; and was, according to Heraclides Ponticus, as quoted by Stephanus, first peopled by a Phœnician colony from Sidon.—According to Mr Tournefort's account, it is about 16 miles in circumference, produces a little wine and cotton, with as much corn as is necessary for the maintenance of 60 or 70 families, who live together in a village at one end of the island, and are mostly Maltese and French corsairs.

This island is remarkable for a subterraneous cavern or grotto, accounted one of the greatest natural curiosities in the world. It was first discovered in the last century by one Magni an Italian traveller, who has given us the following account. "Having been informed (says he) by the natives of Paros, that in the little island of Antiparos, which lies about two miles from the former, of a gigantic statue that was to be seen at the mouth of a cavern in that place, it was resolved that we (the French consul and himself) should pay it a visit. In pursuance of this resolution, after we had landed on the island, and walked about four miles through the midst of beautiful plains and sloping woodlands, we at length came to a little hill, on the side of which yawned a most horrid cavern, that with its gloom at first struck us with terror, and almost repressed curiosity. Recovering the first surprise, however, we entered boldly; and had not proceeded above 20 paces, when the supposed statue of the giant presented itself to our view. We quickly perceived, that what the ignorant natives had been terrified at as a giant, was nothing more than a sparry concretion, formed by the water dropping from the roof of the cave, and by degrees

Antiparos. hardening into a figure which their fears had formed into a monſter. Incited by this extraordinary appearance, we were induced to proceed ſtill further, in queſt of new adventures in this ſubterranean abode. As we proceeded, new wonders offered themſelves: the ſpars, formed into trees and ſhrubs, preſented a kind of petrified grove; ſome white, ſome green; and all receding in due perſpective. They ſtruck us with the more amazement, as we knew them to be the mere productions of Nature, who, hitherto in ſolitude, had, in her playful moments, dreſſed the ſcene, as if for her own amuſement.

"But we had as yet ſeen but a few of the wonders of the place; and we were introduced as yet only into the portico of this amazing temple. In one corner of this half-illuminated receſs, there appeared an opening of about three feet wide, which ſeemed to lead to a place totally dark, and that, one of the natives aſſured us contained nothing more than a reſervoir of water. Upon this we tried, by throwing down ſome ſtones, which, rumbling along the ſides of the deſcent for ſome time, the ſound ſeemed at laſt quaſhed in a bed of water. In order, however, to be more certain, we ſent in a Levantine mariner, who, by the promiſe of a good reward, with a flambeau in his hand, ventured into this narrow aperture. After continuing within it for about a quarter of an hour, he returned, carrying ſome beautiful pieces of white ſpar in his hand, which art could neither imitate nor equal. Upon being informed by him that the place was full of theſe beautiful incruſtations, I venture in once more with him, for about 50 paces, anxiouſly and cautiouſly deſcending by a ſteep and dangerous way. Finding, however, that we came to a precipice which led into a ſpacious amphitheatre, if I may ſo call it, ſtill deeper than any other part, we returned, and being provided with a ladder, flambeaux, and other things to expedite our deſcent, our whole company, man by man, ventured into the ſame opening, and, deſcending one after another, we at laſt ſaw ourſelves all together in the moſt magnificent part of the cavern.

"Our candles being now all lighted up, and the whole place completely illuminated, never could the eye be preſented with a more glittering or a more magnificent ſcene. The roof all hung with ſolid icicles, tranſparent as glaſs, yet ſolid as marble. The eye could ſcarce reach the noble and lofty cieling; the ſides were regularly formed with ſpars; and the whole preſented the idea of a magnificent theatre, illuminated with an immenſe profuſion of lights. The floor conſiſted of ſolid marble; and in ſeveral places magnificent columns, thrones, altars, and other objects appeared as if nature had deſigned to mock the curioſities of art. Our voices, upon ſpeaking or ſinging, were redoubled to an aſtoniſhing loudneſs; and, upon the firing of a gun, the noiſe and reverberations were almoſt deafening. In the midſt of this grand amphitheatre, roſe a concretion of about 15 feet high, that, in ſome meaſure reſembled an altar; from which, taking the hint, we cauſed maſs to be celebrated there. The beautiful columns that ſhot up round the altar, appeared like candleſticks; and many other natual objects repreſented the cuſtomary ornaments of this ſacrament.

"Below even this ſpacious grotto, there ſeemed another cavern; down which I ventured with my former mariner, and deſcended about 50 paces by means of a rope. I at laſt arrived at a ſmall ſpot of level ground, where the bottom appeared different from that of the amphitheatre, being compoſed of ſoft clay, yielding to the preſſure, and in which I thruſt a ſtick to about ſix feet deep. In this, however, as above, numbers of the moſt beautiful cryſtals were formed; one of which, particularly, reſembled a table. Upon our egreſs from this amazing cavern, we perceived a Greek inſcription upon a rock at the mouth; but ſo obliterated by time, that we could not read it. It ſeemed to import, that one Antipater, at the time of Alexander, had come thither; but whether he penetrated into the depths of the cavern, he does not think fit to inform us."

From this account Mr Tournefort's differs conſiderably. Mr Magni mentions only one deſcent or precipice from the entry of the cave to the grotto, or moſt magnificent part: M. Tournefort ſays that there were many very dangerous precipices and rugged ways, thro' which they were obliged to paſs, ſometimes on their back, and ſometimes on their belly; but gives no particular account of his journey till he comes to the grand cavern. This indeed he deſcribes very pompouſly; but as by it he evidently wants to ſupport a favourite hypotheſis, namely, the vegetation of ſtones, perhaps the particulars are not altogether to be depended upon. He informs us, that, at the entry into the cavern, he met with a Greek inſcription almoſt defaced, containing a good number of proper names, and that there was a tradition among the inhabitants, that theſe were the names of ſome who had conſpired againſt Alexander the Great, and having miſſed their aim, had taken refuge in this grotto.

The moſt particular account, however, of this famous grotto that hath hitherto been publiſhed, appeared in the Britiſh magazine, in a letter ſigned *Charles Saunders*, and dated Feb. 24th, 1746-7; which, as it is very particular, and ſeems to bear ſufficient marks of authenticity, we ſhall here inſert. "Its entrance lies in the inſide of a rock, about two miles from the ſea-ſhore; and is a ſpacious and very large arch, formed of rough craggy rocks, overhung with brambles and a great many climbing plants, that give it a gloomineſs which is very awful and agreeable. Our ſurgeon, myſelf, and four paſſengers, attended by ſix guides with lighted torches entered this cavern about eight o'clock in the morning, in the middle of Auguſt laſt. We had not gone 20 yards in this cavity, when we loſt all ſight of day-light: but our guides going before us with lights, we entered into a low narrow kind of alley, ſurrounded every way with ſtones glittering like diamonds by the light of our torches; the whole being covered and lined throughout with ſmall cryſtals, which gave a thouſand various colours by their different reflections. This alley grows lower and narrower as one goes on, till at length one can ſcarce get along it. At the end of this paſſage we were each of us preſented with a rope to tie about our middles; which when we had done, our guides led us to the brink of a moſt horrible precipice. The deſcent into this was quite ſteep, and the place all dark and gloomy. We could ſee nothing, in ſhort, but ſome of our guides with torches in a miſerable dark place, at a vaſt diſtance below us. The dreadful depth of this place, and the horror of the deſcent thro' a miſerable darkneſs into it, made me look back to the lane of diamonds, if I may ſo call it, thro' which we had juſt paſſed, and I could not but think I was leaving heaven, to deſcend into the infernal regions. The hope of ſomething fine at my journey's end, tempted me, however, to truſt myſelf to the rope and my guides at the top, to let myſelf down. After about two minutes dangling in this poſture, not without much pain as well as terror, I found myſelf ſafe, however, at the bottom; and our friends all ſoon followed the example. When we had congratulated here with one another on our ſafe deſcent; I was inquiring where the grotto, as they called it, was. Our guides, ſhaking their heads, told us, we had a great way to that yet; and led us forward about 30 yards under a roof of ragged rocks in a ſcene of terrible darkneſs, and at a vaſt depth from the ſurface of the earth, to the brink of another precipice much deeper and more terrible than the former. Two of the guides went down here with their torches firſt; and by their light we could ſee, that this paſſage was not ſo perpendicular indeed as the other, but lay in a very ſteep ſlant, with a very ſlippery rock for the bottom; vaſt pieces of rough rugged rocks jutting out in many places on the right hand, in the deſcent, and forcing the guides ſometimes to climb over, ſometimes to creep under them, and ſometimes to round them; and on the left, a thouſand dark caverns, like ſo many monſtrous wells, ready, if a foot ſhould ſlip, to ſwallow them up for ever. We ſtood on the edge to ſee theſe people with their lights deſcend before us, and were amazed and terrified to ſee them continue deſcending till they ſeemed at a monſtrous and moſt frightful depth. When they were at the bottom, however, they hollowed to us; and we, trembling and quaking, began to deſcend after them. We had not got 30 feet down, when we came to the place where the rock was perfectly perpendicular; and a vaſt cavern ſeemed to open its mouth to ſwallow us up on one ſide, while a wall of rugged rock threatened to tear us to pieces on the other. I was quite diſheartened at this terrible proſpect, and declared I would go back: but our guides aſſured us there was no danger; and the reſt of the company reſolving to ſee the bottom now they were come ſo far, I would not leave them: ſo on we went to a corner where there was placed an old ſlippery and rotten ladder, which hung down cloſe to the rock; and down this, one after another, we at length all deſcended. When we had got to the bottom of this, we found ourſelves at the entrance of another paſſage, which was terrible enough indeed; but in this there was not wanting ſomething of beauty. This was a wide and gradual deſcent; at the entrance of which one of our guides ſeated himſelf on his breech, and began to ſlide down, telling us we muſt do the ſame. We could diſcover, by the light of his torch, that this paſſage was one of the nobleſt vaults in the world. It is about nine feet high, ſeven wide, and has for its bottom a fine green gloſſy marble. The walls and arch of the roof of this being as ſmooth and even in moſt places as if wrought by art, and made of a fine gliſtering red and white granite, ſupported here and there with columns of a deep blood-red ſhining porphyry, made, with the reflection of the lights, an appearance not to be conceived. This paſſage is at leaſt 40 yards long; and of ſo ſteep a deſcent, that one has enough to do, when ſeated on one's breech, not to deſcend too quickly. Our guides, that we kept with us, could here keep on each ſide of us: and, what with the prodigious grandeur and beauty of the place, our eaſy travelling through it, and the diverſion of our now and then running over one another whether we would or not; this was much the pleaſanteſt part of our journey. When we had entered this paſſage, I imagined we ſhould at the bottom join the two guides we had firſt ſet down; but alas! when we were got there, we found ourſelves only at the mouth of another precipice, down which we deſcended by a ſecond ladder not much better than the former. I could have admired this place alſo, would my terror have ſuffered me; but the dread of falling, kept all my thoughts employed during my deſcent. I could not but obſerve, however, as my companions were coming down after me, that the wall, if I may ſo call it, which the ladder hung by, was one maſs of blood-red marble, covered with white ſprigs of rock-cryſtal as long as my finger, and making, with the glow of the purple from behind, one continued immenſe ſheet of amethyſts. From the foot of this ladder we ſlided on our bellies through another ſhallow vault of poliſhed green and white marble, about 20 feet; and at the bottom of this joined our guides. Here we all got together once again, and drank ſome rum, to give us courage before we proceeded any farther. After this ſhort refreſhment, we proceeded by a ſtrait, but ſomewhat ſlanting paſſage, of a rough, hard, and ſomewhat coarſe ſtone, full of a thouſand ſtrange figures of ſnakes rolled round, and looking as if alive; but in reality as cold and hard as the reſt of the ſtone, and nothing but ſome of the ſtone itſelf in that ſhape. We walked pretty eaſily along this deſcent for near 200 yards; where we ſaw two pillars ſeemingly made to ſupport the roof from falling in: but in reality it was no ſuch thing; for they were very brittle, and made of a fine glittering yellow marble. When we had paſſed theſe about 200 yards, we found ourſelves at the brink of another very terrible precipice: but this our guides aſſured us was the laſt; and there being a very good ladder to go down by, we readily ventured. At the bottom of this ſteep wall, as I may call it, we found ourſelves for ſome way upon plain even ground; but, after about 40 yards walking, were preſented by our guides with ropes again; which we faſtened about our middles, though not to be ſwung down by, but only for fear of danger, as there are lakes and deep waters all the way from hence on the left hand. With this caution, however, we entered the laſt alley: and horrible work it was indeed to get through it. All was perfectly horrid and diſmal here. The ſides and roof of the paſſage were all of black ſtone; and the rocks in our way were in ſome places ſo ſteep, that we were forced to lie all along on our backs, and ſlide down; and ſo rough, that they cut our clothes, and bruiſed us miſerably in paſſing. Over out heads, there were nothing but ragged black rocks, ſome of them looking, as if they were every moment ready to fall in upon us; and, on our left hands, the light of our guides torches ſhowed us continually the ſurfaces of dirty and miſerably looking lakes of water. If I had heartily repented of my expedition often before, here I aſſure you I was all in a cold ſweat, and fairly gave myſelf over for loſt; heartily curſing all the travellers that had written of this place, that they had deſcribed it ſo as

Antiparos. to tempt people to see it, and never told us of the horrors that lay in the way. In the midst of all these reflections, and in the very dismallest part of all the cavern, on a sudden we had lost four of our six guides. What was my terror on this sight! This place was a thousand times darker and more terrible for want of their torches; and I expected no other but every moment to follow them into some of these lakes, into which I doubted not but they were fallen. The remaining two guides said all they could, indeed, to cheer us up; and told us we should see the other four again soon, and that we were near the end of our journey. I don't know what effect this might have upon the rest of my companions; but I assure you I believed no part of the speech but the last, which I expected every moment to find fulfilled in some pond or precipice. Our passage was by this time become very narrow, and we were obliged to crawl on all-fours over rugged rocks; when in an instant, and in the midst of these melancholy apprehensions, I heard a little hissing noise, and saw myself in utter, and not to be described, darkness. Our guides called indeed cheerfully to us, and told us that they had accidentally dropped their torches into a puddle of water, but we should soon come to the rest of them, and they would light them again; and told us there was no danger, and we had nothing to do but to crawl forward. I cannot but say I was amazed at the courage of these people; who were in a place where, I thought, four of them had already perished, and from whence we could none of us ever escape; and determined to lie down and die where I was. Words cannot describe the horror, or the extreme darkness, of the place. One of our guides, however, perceiving that I did not advance, came up to me, and clapping his hand firmly over my eyes, dragged me a few paces forward. While I was in this strange condition, expecting every moment death in a thousand shapes, and trembling to think what the guide meant by this rough proceeding, he lifted me at once over a great stone, set me down on my feet, and took his hand from before my eyes. What words can describe at that instant my astonishment and transport! Instead of darkness and despair, all was splendor and magnificence before me, our guides all appeared about us; the place was illuminated by 50 torches, and the guides all welcomed me into the grotto of Antiparos. The four that were first missing, I now found had only given us the slip, to get the torches lighted up before we came; and the other two had put out their lights on purpose, to make us enter out of utter darkness into this pavilion of splendor and glory. I am now come to the proper business of this letter; which was, to describe this grotto. But I must confess to you that words cannot do it. The amazing beauties of the place, the eye that sees them only can conceive. The best account I can give you, however, pray accept of.

"The people told us, the depth of this place was 485 yards. The grotto, in which we now were, is a cavern of 120 yards wide, and 113 long, and seems about 60 yards high in most places. These measures differ something from the accounts travellers in general give us; but you may depend upon them as exact, for I took them with my own hand. Imagine then with yourself, an immense arch like this, almost all over lined with fine and bright chrystallized white marble, and illuminated with 50 torches; and you will then have some faint idea of the place I had the pleasure to spend three hours in. This, however, is but a faint description of its beauties. The roof, which is a fine vaulted arch, is hung all over with icicles of white shining marble, some of them ten feet long, and as thick as one's middle at the root: and among these there hang 1000 festoons of leaves and flowers of the same substance; but so very glittering, that there is no bearing to look up at them. The sides of the arch are planted with seeming trees of the same white marble, rising in rows one above another, and often inclosing the points of the icicles. From these trees there are also hung festoons, tied as it were from one to another in vast quantities; and in some places among them there seem rivers of marble winding through them in a thousand meanders. All these things are only made, in a long course of years, from the dropping of water, but really look like trees and brooks turned to marble. The floor we trod upon was rough and uneven, with crystals of all colours growing irregularly out of it, red, blue, green, and some of a pale yellow. These were all shaped like pieces of saltpetre; but so hard, that they cut our shoes: among these, here and there, are placed icicles of the same white shining marble with those above, and seeming to have fallen down from the roof and fixed there; only the big end of these is to the floor. To all these our guides had tied torches, two or three to a pillar, and kept continually beating them to make them burn bright. You may guess what a glare of splendor and beauty must be the effect of this illumination, among such rocks and columns of marble. All round the lower part of the sides of the arch are a thousand white masses of marble, in the shape of oak-trees. Mr Tournefort compares them to cauliflowers, but I should as soon compare them to toad-stools. In short, they are large enough to inclose, in many places, a piece of ground big enough for a bed-chamber. One of these chambers has a fair white curtain, whiter than sattin, of the same marble, stretched all over the front of it. In this we all cut our names, and the date of the year, as a great many people have done before us. In a course of years afterwards, the stone blisters out like this white marble over the letters. Mr Tournefort thinks the rock grows like oaks or apple-trees for this reason; but I remember I saw some of the finest cockle and muscle shells, in the rock thereabouts, that ever I saw in my life. I wonder whether he thinks they grow there too. Besides, if this rock grows so fast, the cavern ought to be all grown up by this time; and yet, according to his measures and mine, the cavern seems on the other hand to be turned larger since. Indeed, all that I can gather from his account of this glorious place is, that he had drank a bottle or two too much before he went down into it."

ANTIPAS-HEROD, or HEROD-ANTIPAS, the son of HEROD the Great, by one of his wives called Cleopatra, a native of Jerusalem. Herod the Great, in his first will, appointed Antipas his successor in the kingdom; but afterwards, altering that will, he named his son Archelaus his successor, giving to Antipas the title only of Tetrach of Galilee and Peræa.

Antipas took a great deal of pains in adorning and fortifying the principal places of his dominions. He married the daughter of Aretas king of Arabia; whom he he divorced about the year of Christ 33, to marry his sister-in-law Herodias, wife to his brother Philip, who was still living. St John the Baptist exclaiming continually against this incest, was taken into custody by order of Antipas, and imprisoned in the castle of Machærus, (Mat. xiv. 3, 4. Mark i. 14. vi. 17, 18. Luke iii. 19, 20.) Josephus says, that Antipas caused St John to be laid hold of because he drew too great a concourse of people after him; and that he was afraid lest he should make use of the authority which he had acquired over the minds and affections of the people, to induce them to revolt. But the evangelists, who were better informed than Josephus, as being eye-witnesses of what passed, and acquainted in a particular manner with St John and his disciples, assures us that the true reason of imprisoning St John was, the aversion which Herod and Herodias had conceived against him for the liberty he had used in censuring their scandalous marriage. The virtue and holiness of St John were such, that even Herod feared and respected him; but his passion for Herodias had prevailed with him to have killed that prophet, had he not been restrained by his apprehensions of the people, who esteemed John the Baptist as a prophet. (Mat. xiv. 5, 6.) One day, however, while the king was celebrating the festival of his birth, with the principal persons of his court, the daughter of Herodias danced before him; and pleased him so well, that he promised with an oath to give her whatever she should ask of him. By her mother's advice she asked the head of John the Baptist; upon which the king commanded John to be beheaded in prison, and the head to be given her.—Aretas, king of Arabia, to revenge the affront which Herod had offered to his daughter, declared war against him, and overcame him in a very obstinate engagement. Herod being afterwards detected as a party in Sejanus's conspiracy, was banished by the emperor Caius into Lyons in Gaul; whither Herodias accompanied him.

This Antipas is the Herod who, being at Jerusalem at the time of our Saviour's passion, (Luke xxiii. 11.) ridiculed him, by dressing him in a white robe, and directing him to be conducted back to Pilate, as a mock king, whose ambition gave him no umbrage. The time when Antipas died is not known: however, it is certain he died in exile, as well as Herodias. Josephus says, that he died in Spain, whither Caius upon his coming to Gaul, the first year of his banishment, might order him to be sent.

ANTIPATER, the disciple of Aristotle, and one of Alexander the Great's generals, was a man of great abilities, and a lover of the sciences; but was accused of poisoning Alexander. He subdued the revolted Thracians, relieved Megalopolis, and overthrew the Spartans there. He died 321 years before the Christian æra.

ANTIPATER, an Idumæan of illustrious birth, and possessed of great riches and abilities, taking advantage of the confusion into which the two brothers Hyrcanus and Aristobulus plunged Judea by their contest for the office of high-priest, took such measures as to gain Hyrcanus that office, and under his government to obtain the absolute direction of all affairs; while his great abilities and application to business made him so considerable, that he was honoured as much as if he had been invested with the royal authority in form: but he was at last poisoned by a Jew, named Malachus, 43 years before the Christian æra. He left among his other children, the famous Herod king of the Jews.

ANTIPATER (Cælius), a Roman historian, who wrote a history of the Punic war, much valued by Cicero. The emperor Adrian preferred him to Salust.

ANTIPATER of Sydon, a stoic philosopher, and likewise a poet, commended by Cicero and Seneca: he flourished about the 171st Olympiad. We have several of his epigrams in the *Anthologia*.

ANTIPATHY, in physiology, is formed from the two Greek word, ἀντι *contrary*, and παθος *passion*. Literally taken, the word signifies *incompatibility*: but for the most part the term *antipathy* is not used to signify such incompatibilities as are merely physical; it is reserved to express the aversion which an animated or sensitive being feels at the real or ideal presence of particular objects. In this point of view, which is the light in which we at present consider the term, *antipathy*, in common language, signifies "a natural horror and detestation, an insuperable hatred, and involuntary aversion, which a sensitive being feels for some other object, whatever it is, though the person who feels this abhorrence is entirely ignorant of its cause, and can by no means account for it." Such is, they say, the natural and reciprocal hostility between the salamander and the tortoise; between the toad and the weasel; or between sheep and wolves. Such is the invincible aversion of particular persons against cats, mice, spiders, &c.: a prepossession which is sometimes so violent, as make them faint at the sight of these animals. Of these and a thousand other antipathies the ancient naturalists, the schoolmen, and the vulgar, form so many legends; and relate them as certain facts, that they may demand an explication of them from the philosophers. But these sages begin with investigating whether such antipathies actually exist or not.

To explore the matter without prejudice, we shall find it necessary to abstract from the subjects of this disquisition, 1. All such antipathies as are not ascertained; as that which is supposed to be felt by hens at the sound of an harp whose strings are made of a fox's bowels, between the salamander and tortoise, and between the weasel and the toad. Nothing is less confirmed, or rather nothing is more false, than these facts, with which vulgar credulity and astonishment are amused and actuated: and though some of these antipathies should be ascertained, this would be no proof that the animals which feel them are not acquainted with their causes, according to their mode and proportion of knowledge; in which case it will be no longer the antipathy which we have defined.

2. We must abstract those antipathies which can be extinguished or resumed at pleasure; those fictitious aversions, which certain persons feel, or pretend to feel, with affected airs, that they may appear more precise and finical, or singularly and prodigiously elegant; that they may seem to have qualities so exquisitely fine, as require to be treated with peculiar delicacy. One who bestows any attention on the subject, would be astonished to find how many of these chimerical aversions there are, which are pretended, and passed upon the world by those who affect them, as natural and unconquerable.

3. When we abstract those aversions the, causes of which

Antipathy. which are known and evident; we ſhall be ſurpriſed, after our deduction of theſe pretended antipathies from the general ſum, how ſmall, how inconſiderable, is the quantity of thoſe which are conformable to our definition. Will any one pretend to call by the name of *antipathy*, thoſe real, innate, and inconteſtable averſions which prevail between ſheep and wolves? Their cauſe is obvious: the wolf devours the ſheep, and ſubſiſts upon his victim; and every animal naturally flies with terror from pain or deſtruction: ſheep ought therefore to regard wolves with horror, which for their nutrition tear and mangle the unreſiſting prey. From principles ſimilar to this, ariſe that averſion which numbers of people feel againſt ſerpents; againſt ſmall animals, ſuch as reptiles in general, and the greateſt number of inſects. During the credulous and ſuſceptible period of infancy, pains have been taken to impreſs on our minds the frightful idea that they are venomous; that their bite is mortal; that their ſting is dangerous, productive of tormenting inflammations or tumours, and ſometimes fatal: they have been repreſented to us as ugly and ſordid; as being, for that reaſon, pernicious to thoſe who touch them; as poiſoning to thoſe who have the misfortune to ſwallow them. Theſe horrible prepoſſeſſions are induſtriouſly inculcated from our infancy; they are ſometimes attended and ſupported by diſmal tales, which are greedily imbibed, and indelibly engraven on our memories. It has been taught us both by precept and example, when others at their approach have aſſumed in our view the appearance of deteſtation and even of terror, that we ſhould fly from them, that we ſhould not touch them. Is it then wonderful (if our falſe impreſſions as to this ſubject have been corrected neither by future reflections nor experiments), that we ſhould entertain, during our whole lives, an averſion for theſe objects, even when we have forgot the admonitions, the converſations, and examples, which have taught us to believe and apprehend them as noxious beings? and in proportion to the ſenſibility of our frame, in proportion as our nerves are irritable, our emotions at the ſight of what we fear will be more violent, eſpecially if they anticipate our expectation, and ſeize us unprepared, thought our ideas of what we have to fear from them are the moſt confuſed and indiſtinct imaginable. To explain theſe facts, is it neceſſary to fly to the exploded ſubterfuge of occult qualities inherent in bodies, to latent relations productive of antipathies, of which no perſon could ever form an idea?

It is often ſufficient to influence a perſon who had formerly no averſion for an object, if he lives with ſome other aſſociate who gives himſelf up to ſuch capricious panics; the habit is inſenſibly contracted to be agitated with diſagreeable emtions at the preſence of an object which had been formerly beheld with indifference and cold blood. I was acquainted (ſays the author of the article *Antipathy* in the French Encyclopédie) with a perſon of a very ſound underſtanding, whom thunder and lightning by no means terrified; nay, to whom the ſpectacle appeared magnificent and the ſound majeſtic; yet to a mind thus ſeemingly fortified againſt the infectious of terror, no more was neceſſary than ſpending the ſummer with a friend in whom the appearance of lightning excited the ſtrongeſt emotions, and whom the remoteſt clap of thunder affected with extravagant paroxiſms, to become timid in exceſs at the approach of thunder; nor could he ever afterwards ſurmount the fear which it inſpired.—The frightful ſtories of dogs and cats, which have killed their maſters, or which have given them mortal wounds, are more than ſufficient to inſpire a timorous perſon with averſion againſt theſe animals; and if the olfactory nerves of ſuch a perſon be delicate, he will immediately diſcover the ſmell of them in a chamber: diſturbed by the apprehenſion which theſe effluvia excite in his mind, he gives himſelf up to the moſt violent uneaſineſs, which is tranquillized when he is aſſured that the animal is no longer in the room. If by chance, in the ſearch which is made to calm the uneaſineſs of this timorous perſon, one of theſe creatures ſhould at laſt be diſcovered, every one preſently exclaims, *A miracle!* and admits the reality of *antipathies* into his creed; whilſt all this is nothing but the effect of a childiſh fear, founded on certain confuſed and exaggerated ideas of the hazard which one may run with theſe animals. The *antipathy* which ſome people entertain againſt eels, though they are eaten by others with pleaſure, ariſe from nothing but the fear of ſerpents, to which theſe fiſhes are in ſome degree ſimilar. There are likewiſe other *antipathies* which do not originate in the imagination, but ariſe from ſome natural incongruity; ſuch as we often remark in children, for particular kinds of victuals, with which their taſte is not offended, but which their ſtomachs cannot digeſt, and which are therefore diſgorged as ſoon as ſwallowed.

To what then are thoſe *antipathies*, of which we have heard ſo much, reducible? Either to legendary tales; or to averſions againſt objects which we believe dangerous; or to a childiſh terror of imaginary perils; or to a diſreliſh, of which the cauſe is diſguiſed; or to a ridiculous affectation of delicacy; or to an infirmity of the ſtomach; in a word, to a real or pretended reluctance for things which are either inveſted, or ſuppoſed to be inveſted, with qualities hurtful to us. Too much care cannot be taken in preventing, or regulating, the *antipathies* of children; in familiariſing them with objects of every kind; in diſcovering to them, without emotion, ſuch as are dangerous; in teaching them the means of defence and ſecurity, or the methods of eſcaping their noxious influence; and, when the rational powers are matured by age, in reflecting on the nature of thoſe objects which we fear, in aſcertaining what has been told concerning their qualities, or in vigorouſly operating upon our own diſpoſitions to overcome thoſe vain repugnancies which we may feel. See Sympathy, which is the oppoſite of *Antipathy*.

Antipathy, in ethics, hatred, averſion, repugnancy. *Hatred* is entertained againſt perſons; *averſion*, and *antipathy*, indiſcriminately againſt perſons or things; and *repugnancy*, againſt actions alone.

Hatred is more voluntary than *averſion*, *antipathy*, or *repugnancy*. Theſe laſt have greater affinity with the animal conſtitution. The cauſes of antipathy are leſs known than thoſe of a *averſion*. *Repugnancy* is leſs permanent than either the one or the other.—We hate a vitious character, we feel *averſion* to its exertions: we are affected with antipathy for certain perſons at firſt ſight; there are ſome affairs which we tranſact with *repugnancy*—*Hatred* calumniates; *averſion* keeps us at a diſtance from certain perſons; antipathy makes us us deteſt them; *repugnancy* hinders us from imitating them.

ANTIPATRIS (Acts xxiii. 31.), a town of Paleſtine, anciently called *Caphar-Saba*, according to Joſephus, but named *Antipatris* by Herod the Great, in honour of his father Antipater. It was ſituated in a pleaſant valley, near the mountains, in the way from Jeruſalem to Cæſarea. Joſephus places it at about the diſtance of ſeventeen miles from Joppa.

ANTIPELARGIA, among the ancients, a law, whereby children are obliged to furniſh neceſſaries to their aged parents. The ciconia, or ſtork, is a bird famous for the care it takes of its parents when grown old. Hence, in ſome Latin writers, this is rendered *lex ciconiaria*, or the ſtorks law.

ANTIPHONARY, ANTIPHONARIUM, a ſervice-book which contained all the invitatories, reſponſories, collects, and whatever elſe was ſung or ſaid in the choir, except the leſſons. This is otherwiſe called *reſponſarium*, from the reſponces therein contained. The author of the Roman *antiphonary* was pope Gregory the Great. We alſo find mention of nocturnal and diurnal *antiphonaries*, for the uſe of the daily and nightly offices; ſummer and winter *antiphonaries*; alſo *antiphonaries* for country churches, &c. By the provincial conſtitutions of archbiſhop Winchelſey, made at Merton, A. D. 1305, it is required that one of theſe ſhould be found in every church within the province of Canterbury. The uſe of theſe, and many other popiſh books, were forbid by the 3d and 4th of Edward VI. c. 10.

ANTIPHONY, the anſwer made by one choir to another, when the pſalm or anthem is ſung between two.

ANTIPHONY, ſometimes denotes a ſpecies of pſalmody, wherein the congregation, being divided into two parts, repeat the pſalms, verſe for verſe, alternately. In this ſenſe, antiphony ſtands contradiſtinguiſhed from ſymphony, where the whole congregation ſings together.

Antiphony differs from reſponſorium, becauſe in this latter the verſe is only ſpoken by one perſon, whereas in the former, the verſes are ſung by the two choirs alternately. The original of Antiphonal ſinging in the weſtern churches is referred to the time of St Ambroſe, about the year 374. That father is ſaid to have firſt introduced it into the church of Milan, in imitation of the cuſtom of the eaſtern church, where it appears to be of greater antiquity, though as to the time of its inſtitution, authors are not agreed; it was moſt probably introduced at Antioch, between the year of Chriſt 347 and 356.

ANTIPHONY is alſo uſed to denote the words given out at the beginning of the pſalm, to which both the choirs are to accommodate their ſinging.

ANTIPHONY, in a more modern ſenſe, denotes a kind of compoſition made of ſeveral verſes extracted out of different pſalms, adapted to expreſs the myſtery ſolemnized on the occaſion.

ANTIPODES, in geography, a name given to thoſe inhabitants of the globe that live diametrically oppoſite to each other. The word is Greek, and compounded of αντι, *oppoſite*, and πος, *a foot*; becauſe their feet are oppoſite to each other.

The antipodes lie under oppoſite meridians and oppoſite parallels; in the ſame degree of latitude, but of oppoſite denominations, one being north and the other ſouth. They have nearly the ſame degree of heat and cold, days and nights of equal length, but in oppoſite ſeaſons. It is noon to one, when midnight to the other; and the longeſt day with the one, is the ſhorteſt with the other.

Plato is eſteemed the firſt who thought it poſſible that the antipodes ſubſiſted, and is looked upon as the inventor of the word. As this philoſopher apprehended the earth to be ſpherical, he had only one ſtep to make to conclude the exiſtence of the antipodes.

The ancients, in general, treated this opinion with the higheſt contempt; never being able to conceive how men and trees could ſubſiſt ſuſpended in the air with their feet upwards, for ſo they apprehended they muſt be in the other hemiſphere.

They never reflected that theſe terms *upwards* and *downwards* are merely relative; and ſignify only nearer to, or farther from, the centre of the earth, the common centre to which all heavy bodies gravitate; and that, therefore, our antipodes have not their feet upwards and head downwards any more than ourſelves; becauſe they, like us, have their feet nearer the centre of the earth, and their heads farther from it. To have the head downwards and feet upwards, is to place the body in a direction of gravity tending from the feet to the head: but this cannot be ſuppoſed with regard to the antipodes; for they, like us, tend toward the centre of the earth, in a direction from head to foot.

ANTIPOLIS (anc. geog.), now ANTIBES, on the coaſt of Provence, a colony of the Maſſilians, near the river Verus, in Gallia Narbonenſis (Livy), three leagues to the weſt of Nice. E. Long. 7° Lat. 43° 40′.

ANTIQUARE, among Roman lawers, properly denotes the rejecting of a new law, or refuſing to paſs it. In which ſenſe, *antiquating* differs from *abrogating*; as the latter imports the annulling an old law, the former the rejecting a new one.

ANTIQUARE is alſo uſed for a law's growing obſolete, or into diſuſe, either by age or non-obſervance.

ANTIQUARII, a name given to copies of old books. After the decline of learning amongſt the Romans, and when many religious houſes were erected, learning was chiefly in the hands of the clergy; the greateſt number of whom were regulars, and lived in monaſteries. In theſe houſes were many induſtrious men, who were continually employed in making new copies of old books, either for the uſe of the monaſtery or for their own emolument. Theſe writing monks were diſtinguiſhed by the name of *Antiquarii*. They deprived the poor librarii, or common ſcriptores, of great part of their buſineſs, ſo that theſe found it difficult to gain a ſubſiſtence for themſelves and families. This put them upon finding out more expeditious methods of tranſcribing books. They formed the letters ſmaller, and made uſe of more jugations and abbreviations than had been uſual. They proceeded in this manner till the letters became exceedingly ſmall; the abbreviations were very numerous, and extremely difficult to be read. This in ſome meaſure accounts for the great variety of hands in the ſpecies of writing called *Modern Gothic*. When a number of copies were to be made of the ſame work, it was uſual to employ ſeveral perſons at the ſame time in writing it; each perſon, except him who wrote the first skin, began where his fellow was to leave off.

ANTIQUARY, a person who studies and searches after monuments and remains of antiquity, as old medals, books, statues, sculptures, and inscriptions, and, in general all curious pieces that may afford any light into antiquity.

In the chief cities of Greece and Italy, there were persons of distinction called *antiquaries*, whose business it was to show strangers the antiquities of the place, to explain the ancient inscriptions, and to give them all the assistance they could in this way of learning.—Pausanias calls these antiquaries Εξηγηται. The Sicilians call them *mystogogi*.

There was an ancient college of antiquaries erected in Ireland by Ollamh Fodhla, 700 years before Christ, for composing a history of that country: And to this, say the Irish historians, it is owing that the history and antiquities of that kingdom may be traced back beyond those of most other nations.

There is a society of antiquaries in London, and another in Edinburgh, incorporated by the king's charter. See SOCIETY.

ANTIQUARY is also used by ancient writers for the keeper of the antiquarian or cabinet of antiquities. This officer is otherwise called *archæota*, or antiquary of a king, a prince, a state, or the like.

Henry VIII. gave John Leland the title of his *antiquary;* a title which, says the author of his life, no body ever enjoyed besides himself. But the restriction, we suppose, was only intended to be understood in respect of the kings of England. M. Schott, we find, had the title of *antiquary* to the king of Prussia; P. Pedruzzi, that of *antiquary* to the Duke of Parma; M. Galland resided some time in Turky under the title of *antiquary* of the king of France.—The university of Oxford have still their antiquary under the denomination of *custos archivorum*.—The kings of Sweden have been at great expences in order to illustrate the antiquity of their country, having established an academy of antiquaries with this single view.—The office of the ancient Irish antiquaries was to preserve the genealogies of the kings of Ireland, to correct the regal tables of succession, and deliver down the pedigree of every collateral branch of the royal family.

ANTIQUATED, something obsolete, out of date, or out of use.

ANTIQUE, in a general sense, something that is ancient: but the term is chiefly used by sculptors, painters, and architects, to denote such pieces of their different arts as were made by the ancient Greeks and Romans. Thus we say, an antique bust, an antique statue, &c.

ANTIQUE is sometimes contradistinguished from *ancient*, which signifies a less degree of antiquity. Thus, antique architecture is frequently distinguished from ancient architecture.

ANTIQUITIES, a term implying all testimonies, or authentic accounts, that have come down to us of ancient nations. Bacon calls antiquities *the wrecks of history*, or such particulars as industrious and learned persons have collected from genealogies, inscriptions, monuments, coins, names, etymologies, archives, instruments, fragments of history, &c.

Antiquities, from a very extensive science, including "an historical knowledge of the edifices, magistrates, offices, habiliments, manners, customs, ceremonies, worship, and other objects worthy of curiosity, of all the principal ancient nations of the earth."

This science is not a matter of mere curiosity, but is indispensible to the theologian; who ought to be thoroughly acquainted with the antiquities of the Jews, to enable him properly to explain numberless passages in the Old and New Testaments: to the lawyer, who, without the knowledge of the antiquities of Greece and Rome, can never well understand, and properly apply, the greatest part of the Roman laws: to the physician and the philosopher, that they may have a complete knowledge of the history and principles of the physic and philosophy of the ancients: to the critic, that he may be able to understand and interpret ancient authors: to the orator and poet, who will be thereby enabled to ornament their writings with numberless images, illusions, comparisons, &c.

Antiquities are divided into sacred and profane, into public and private, universal and particular, &c. It is true, that the antiquaries (especially such as are infected with a spirit of pedantry, and the number of these is great) frequently carry their inquiries too far, and employ themselves in laborious researches after learned trifles: but the abuse of a science ought never to make us neglect the applying it to rational and useful purposes.

Many antiquaries also restrain their learned labours to the ecclaircissement of the antiquities of Greece and Rome: but this field is far too confined, and by no means contains the whole of this science, seeing it properly includes the antiquities of the Jews, the Egyptians, Persians, Phœnicians, Carthaginians Hetruscans, Germans, and in general, all those principal nations mentioned in ancient history: so far as any accounts of them are come down to us.

If to the general subjects above mentioned we add the particular study of antiques, of the statues, bass-reliefs, and the precious relics of architecture, painting, camaieus, medals, &c. it is easy to conceive that antiquities form a science very extensive and very complicated, and with which only a very small acquaintance could have been attainable by any one man, if our predecessors had not prepared the way for us; if they had not left us such inestimable works as those of Gronovius, Grævius, Montfaucon, Count Caylus, Winckelman, the Hebraic antiquities of D. Iken of Bremen, the Grecian antiquities of Brunings, the Roman antiquities of Nieupoort, and especially that work which is intitled *Bibliographia Antiquaria Joh. Alberti Fabricii*, professor at Hamburg; &c. &c. Nor must we here forget that very valuable work, with which Mr Robert Wood has lately enriched this science, and which is so well known, and so justly esteemed by all true connoisseurs, under the title of the *Ruins of Palmyra* and those of *Balbeck*. It is by this work that we are fully convinced of the grandeur and magnificence, the taste and elegance, of the buildings of the ancients. We here see that the invention of these matters is not all owing to the Greeks, but that there were other nations who served them as models. For, though many of the edifices of Palmyra are to be attributed to the emperor Aurelian, and to Odenatus and his wife Zenobia, who reigned there about the year 264, 264, yet there are found, at the same place, ruins of buildings, that appear to be of far greater antiquity, and that are not less beautiful. The ancient Persepolis is sufficient to prove this assertion. When we duly reflect on all these matters, and especially if we attempt to acquire any knowledge of this science, we shall soon be convinced that it but ill becomes a petit-maitre to laugh at a learned antiquary.

The knowledge of those monuments of the ancients, the works of sculpture, statuary, graving, painting, &c. which they call *antiques*, requires a strict attention, with regard to the matter itself on which the art has been exercised; as the wax, clay, wood, ivory, stones of every kind, marble, flint, bronze, and every sort of metal. We should begin by learning on what matter each ancient nation principally worked, and in which of the fine arts they excelled. For the matter itself, as the different sorts of marble, compositions of metals, and the species of precious stones, serve frequently to characterize the true antique, and to discover the counterfeit. The connoisseurs pretend also to know, by certain distinct characters in the design and execution of a work of art, the age and nation where it was made. They find, moreover, in the invention and execution, a degree of excellence, which modern artists are not able to imitate. Now, though we ought to allow, in general, the great merit of the ancients in the polite arts, we should not, however, suffer our admiration to lead us into a blind superstition. There are pieces of antiquity of every sort, which have come down to us; some that are perfectly excellent; and others so wretched, that the meanest among modern artists would not acknowledge them. The mixture of the good and bad has taken place in all subjects, at all times, and in all nations. The misfortune is, that most of our great antiquaries have been so little skilled in designing, as scarcely to know how to draw a circle with a pair of compasses. It is prejudice, therefore, which frequently directs them to give the palm to the ancients, rather than a judgment directed by a knowledge of the art. That character of expression, which they find so marvellous in the works of antiquity, is often nothing more than a mere chimera. They pretend that the artists of our days constantly exaggerate their expressions; that a modern Bacchus has the appearance of a man distracted with intoxication; that a Mercury seems to be animated with the spirit of a fury; and so of the rest. But let them not decide too hastily. Almost all the antique figures are totally void of all spirit of expression; we are forced to guess at their characters. Every artificial expression requires, moreover, to be somewhat exaggerated. A statue or portrait is an inanimate figure; and must therefore have a very different effect from one which, being endowed with life, has the muscles constantly in play, and where the continual change of the features, the motion of the eyes, and the looks, more or less lively, easily and clearly express the passions and sentiments. Whereas in a figure that is the produce of art, the delicate touches, that should express the passions, are lost to the eyes of the spectators: they must therefore be struck by strong, bold characters, which can affect them at the first glance of the eye. A very moderate artist is sensible, at the same time, that he is not to give his figures extravagant expressions, nor to place them in distorted attitudes.

ANTIQUITY signifies times or ages past long ago. Thus, we say, the heroes of antiquity, &c.

ANTIQUITY is also used to denote the works or monuments of antiquity. See ANTIQUITIES.

ANTIQUITY likewise expresses the great age of a thing; and in this sense we say the antiquity of a family, the antiquity of a kingdom.

ANTIRRHINUM, SNAP-DRAGON, or CALVES-SNOUT: A genus of the angiospermia order, belonging to the didynamia class of plants; and in the natural method ranking under the 40th order, *Personatæ*. The essential characters are these: The calyx consists of five leaves; the basis of the corolla is bent backwards, and furnished with pectoria; the capsule is bilocular. There are 14 species of the antirrhinum, 10 of which are natives of Britain, viz. the cymbalaria, or ivy-leaved toad-grass; the elatine, or sharp-pointed fluellin; the spurium or round-leaved fluellin; the arvense, or corn-blue toad-flax; the repens, or creeping toad-flax; the monospermum, or sweet-smelling toad-flax; the linaria, ar common yellow-toad-flax; the minus, or less toad-flax: the majus, or greater snap-dragon; and the orontium, or least snap-dragon. The linaria is said to be cathartic and diuretic; but it is not used in the shops.

ANTIRRHIUM (anc. geog.), a promontory at the mouth of the Corinthian bay, where it is scarce a mile broad, and where it separates the Ætolians from the Peloponnesus; so called from its opposite situation to Rhium in Peloponnesus, (Pliny): both are now called the *Dardanelles* of *Lepanto*.

ANTISABBATARIANS, a modern religious sect, who oppose the observance of the Christian sabbath. The great principle of the Antisabbatarians is, that the Jewish sabbath was only of ceremonial, not moral obligation; and consequently is abolished by the coming of Christ.

ANTISAGOGE, in rhetoric, a figure differing little from that called *concession*. The following passage from Cicero is an instance of it: *Difficilis ratio belli gerendi; at plena Fidei, plena pietatis: & si dicas, magnus labor, multa pericula proponuntur; at gloria ex his immortalis est consecutura*. See CONCESSION.

ANTISCII, in geography, people who live on different sides of the equator, whose shadows at noon are projected opposite ways. Thus the people of the north are Antiscii to those of the south; the one projecting their shadows at noon towards the north pole, and the other toward the south pole.

ANTISCORBUTICS, medicines good in scorbutic cases.

ANTISEPTICS (from αντι and σηπτος *putrid*, of σηπω, *to putrify*), an appellation given to such substances as resist putrefaction.

We have some curious experiments in relation to antiseptic substances by Dr Pringle, who has ascertained their several virtues. Thus in order to settle the antiseptic virtue of salts, he compared it with that of common sea-salt; which being one of the weakest, he supposes equal to unity, and expresses the proportional strength of the rest by higher numbers, as in the following table.

Salts, their antiseptic virtue.

Sea-salt -	1	Saline mixture -	3
Sal gemma -	1+	Nitre - -	4+
Tartar vitriolated	2	Salt of hartshorn	4+
Spiritus Mindereri	2	Salt of wormwood	4+
Tartarus solubilis	2	*Borax* - -	12+
Sal diureticus -	2+	Salt of amber -	20+
Crude *sal ammoniac*	3	Alum - -	30+

In this table the proportions are marked in integral numbers: only to some there is added the sign +, to show, that those salts are possessed of a stronger antiseptic virtue than the number in the table expresses, by some fractions; unless in the three last, where the same sign imports, that the salt may be stronger by some units.

Some resinous and other substances even exceed the antiseptic virtues of the neutral salts; thus myrrh, asafætida, terra japonica, and aloes, are at least twelve times more antiseptic than sea-salt. Two grains of camphor is equivalent to sixty grains of that salt. An infusion of a few grains of Virginian snake-root, in powder, exceeds twelve times its weight of sea-salt. Comomile flowers have nearly the same extraordinary quality. The Jesuits bark has it also. Besides these, pepper, ginger, saffron, contrayerva-root, are twelve times more antiseptic than sea-salt. Dried sage, rhubarb, the root of the wild valerian, mint, angelica, ground ivy, senna, green tea, red roses, wormwood, mustard, and horse-radish, were likewise found more antiseptic than the standard.

To the class of antiseptic medicines may likewise be added fermented liquors, acids, spirits, and even those plants called *anti-acids*, and erroneously supposed hasteners of putrefaction, particularly horse-radish. Now vegetables, possessing this virtue, are the more valuable, in that being usually free of acrimony, they may be taken in much greater quantities than either spirits, acids, resins, or even the neutral salts.

Antiseptics are prescribed in all putrid, malignant, and pestilential cases. It is to be remarked, however, that different kinds of them are to be given in different diseases, and even in different stages of the same disease. Thus, the bark is a specific in a gangrene, when the vessels are relaxed, and the blood resolved or disposed to putrefaction; but will fail, if the vessel are too full, or the blood be too thick. With the same caution is the bark to be used in wounds, viz. chiefly in cases of absorbed matter, when it infects the humours, and brings on a hectic fever.

By the great antiseptic virtue of alum, the bark, and other astringents, it should seem, that astriction had no small share in the cure of putrid disorders; and, indeed, the very nature of putrefaction consists in a separation or disunion of the parts. But as astringents are improper to be administered in many cases, contrayerva-root, snake-root, camphor, &c. may supply their place; which, though, highly antiseptic, have very little, if any, of an astringent quality.

ANTISPASMODICS, are medicines proper for the cure of spasms and convulsions. Opium, balsam of Peru, and the essential oils of many vegetables, are the principal in this class of medicines. Opium excels, for its immediate effects. Peruvian balsam, in many instances, produces more lasting benefit than opium, and sometimes succeeds where opium fails. As antispasmodics, the essential oils differ in this from opium, that they act more on a particular part than on the system in general, and have no soporific effect. Some medicines remove spasms by immediate contact, as asses milk, cream, oil of almonds; others by repelling heat, as gas, sulphur, nitre, sal ammoniac, &c. And where the strictures are produced by inanition and a defect of vital heat, spasms are removed by those medicines that restore the *vis vitæ*, such as valerian, castor, musk, &c.

ANTISTASIS, in oratory, a defence of an action from the consideration that had it been omitted worse would have ensued. This is called by Latin writers *comparativum argumentum*; such, *e. gr.* would be the general's defence who had made an inglorious capitulation, That without it, the whole army must have perished.

ANTISTHENES, a Greek philosopher, and founder of the Cynics. He was born at Athens, and passed the former part of his life as a soldier. Having afterwards been an attendant at the lectures of Socrates, he was principally charmed with those exhortations of that great philosopher, which persuaded to frugality, to temperance, and to moderation: these Antisthenes was resolved to practise by carrying every precept to its utmost extent. Permitting therefore his beard to grow, he went about the streets in a thread-bare coat, scarcely to be distinguished from a common beggar. He prided himself upon the most rigid virtue, and thought himself obliged to attack the vicious wherever he found them. This gave him some reputation in the city; but it may be supposed, that, in a place so very luxurious as Athens, he had more enemies than disciples. His philosophy consisted rather in action than speculation: it was therefore his constant maxim, That to be virtuous was to be happy, and that all virtue consisted in action; that the wise man should live for himself, contented in all situations, and happy alone in the consciousness of his own virtue. He acknowledged nothing to be good but was was honourable; and asserted, that virtue might be acquired by practice. Laertius tells us there were 10 tomes of his works; and he has given us many of his apophthegms.

ANTISTOECHON, in grammar, the using one letter instead of another; as *olli* for *illi*.

ANTISTROPHE, in grammar, a figure by which two things mutually depending on one another, are reciprocally converted; as, *the servant of the master, the master of the servant.*

ANTISTROPHE, among lyric poets, that part of a song and dance in use among the ancients, which was performed before the altar, in returning from west to east in opposition to strophe. See STROPHE and ODE.

ANTITACTÆ, in church history, a branch of Gnostics, who held, that God was good and just, but that a creature had created evil; and consequently that it is our duty to oppose this author of evil, in order to avenge God of his adversary.

ANTITHENAR, in anotomy, a name given to the adductor incicis. See ANATOMY, *Table of the Muscles*.

ANTITHESIS, in rhetoric, a contrast or opposition of words or setiments. Such is that of Cicero, in the second Catilinarian: "On one side stands modesty, on the other impudence; on one fidelity, on the other deceit; here piety, there sacrilege; here continency, there lust, &c." Such also is that of Augustus to some seditious young men: *Audite, juvenes, senem, quem juvenem senes audivere*. Such again is that of Seneca; *Curæ leves loquuntur, ingentes stupent*. And that of Virgil:

Flectere si nequeo superos, Acheronta movebo.

St Augustine, Seneca, Salvian, and many other ancient writers, seem greatly to affect antithesis; but among the moderns they are generally decried. Desmaretz represents them as the favourites of young writers. The following is an example of modern antithesis:

——Though gentle, yet not dull;
Strong, without rage; without o'erflowing, full.

Antithesis is sometimes used for controversy. In this sense, we meet with *antithetic* method, *antithetic* discourses, &c. Marcion composed a volume of Antitheses, or contrarieties and oppositions between the law and the gospel.

ANTITRAGUS musculus, in anatomy, a muscle of the ear. See Anatomy, *Table of the Muscles*.

ANTITRINITARIANS, those who deny the Trinity, and teach that there are not three persons in the Godhead. Thus in the Samosatenians, who do not believe the distinction of persons in God; the Arians, who deny the divinity of the Word; and the Macedonians, who deny that of the Holy Spirit, are all properly Antitrinitarians. Among the moderns, Antitrinitarians are particularly understood of Socinians, called also Unitarians.

The *Bibliotheca Antitrinitariorum*, or *Antitrinitarian Library*, is a posthumous work of Christopher Sandius, an eminent Antitrinitarian; wherein he gives a list, digested in order of time, of all the Socinian or modern Antitrinitarian authors, with a brief account of their lives, and a catalogue of their works. See Unitarian.

ANTITYPE, a Greek word, properly signifying a type or figure correspondent to some other type.

The word antitype occurs twice in the New Testament; viz. in the Epistle to the Hebrews, ix. 24. and in St Peter, 1 Ep. iii. 21. where its genuine import has been much controverted. The former says, that "Christ is not entered into the holy places made with hands, which are *αντιτυπα*, the figures or antitypes of the true—now to appear in the presence of God for us." Now *τυπος*, signifies the pattern by which another thing is made; and as Moses was obliged to make the tabernacle, and all things in it, according to the pattern showed him in the mount; the tabernacle so formed was the antitype of what was shown to Moses: any thing, therefore, formed according to a model or pattern, is an antitype. In the latter passage, the Apostle, speaking of Noah's flood, and the deliverance only of eight persons in the ark from it, says, *Ω και ημας αντιτυπον νυν σωζει βαπτισμα*, *baptism, being an antitype to that, now saves us; not putting away the filth of the flesh, but the answer of a good conscience towards God, &c.* The meaning is, that righteousness, or the answer of a good conscience towards God, now saves us by means of the resurrection of Christ, as formerly righteousness saved those eight persons by means of the ark, during the flood. The word antitype, therefore, here signifies a general similitude of circumstances; and the particle *ω*, *whereunto*, refers, not to the immediate antecedent, *υδατος*, *water*, but to all that precedes.

Antitype, among the ancient Greek fathers, and in the Greek liturgy, is also applied to the symbols of bread and wine in the Sacrament. Hence it hath been argued, by many Protestants, that the Greeks do not really believe the doctrine of transubstantiation; because they call the bread and wine *antitypes*, *αντιτυπα*, q. d. figures, similitudes; and this even after the consecration.

ANTIUM, (anc. geog.) a city of the Volsci, (Livy); situated on the Tuscan sea, yet without a harbour, because they had a neighbouring hamlet, called *Ceno*, with a harbour, (Strabo). The Romans gained the first reputation in naval affairs against the Antiates; part of whose ships they conveyed into the arsenal of Rome, and part they burnt; and with their beaks or rostra adorned the pulpit erected in the Forum, thence called *Rostra*, (Livy, Florus). Here stood a famous temple of Fortune, (Horace). Addison says, there were two Fortunæ worshipped at Antium.—It is now extinct, but the name still remains in the *Capo de' Anzo*.

ANTIVARI, a strong town of Turky, in Europe, in Dalmatia, a Greek archbishop's see, and subject to the Turks. E. Lon. 29. 15. N. Lat. 43. 0.

ANTLER, among sportsmen, a start or branch of a deer's attire.

Brow-Antler, denotes the branch next the head; and,

Bes-Antler, the branch next above the brow-antler.

ANTLIA, an ancient machine, supposed to be the same with our pump. Hence the phrase, *in antliam condemnari*, according to the critics, denotes a kind of punishment, whereby criminals were condemned to drain ponds, ditches, or the like.

ANTOEICI, in geography, those inhabitants of the earth who live under the same meridian, and at the same distance from the equator; the one toward the north, and the other toward the south. Hence they have the same longitude; and their latitude is also the same, but of a different denomination. They are in the same semicircle of the meridian, but opposite in parallels. They have precisely the same hours of the day and night, but opposite seasons; and the night of the one is always equal to the day of the other.

ANTOINE, a town of France, in Dauphiny, in the diocese of Vienne, with a celebrated abbey. It is seated among the mountains, 13 miles east of Lyons. E. Lon. 5. 20. N. Lat. 45. 43.

ANTONA, (Tacitus); a river of Britain, which Camden supposes to be a faulty reading for Avuona or Aufona, (the Avon).

ANTONACUM, Antonnacum, or Antunnacum, a town of the Treveri; now *Andernach* below Coblentz. E. Lon. 7° 5′. Lat. 50° 25′.

ANTONIA, a citadel of Jerusalem, the origin of which we have in Josephus; who says, that Hyrcanus, the first high-priest of that name, built Baris near the temple, a house with turrets, where he generally resided fided. Herod afterwards made it ftronger, for the fecurity and defence of the temple; and in honour of Marc Anthony, who then commanded in the eaft, called it *Antonia*. It was very extenfive, and could accommodate a Roman legion: from it there was a full view of the temple.

ANTONIA (St), a town of France, in Rouergue, in the diocefe of Rhodez, whofe fortifications are demolifhed. It is feated on the river Aveirou. E. Lon. 0. 55. N. Lat. 44. 10.

ANTONIAN WATERS, medical waters of Germany, very pleafant to the tafte, and efteemed good in many chronic and hypochondriac cafes. See TONSTEIN.

ANTONIANO (Silvio), a man of great learning, who raifed himfelf from a low condition by his merit, was born at Rome in the year 1540. When he was but ten years old, he could make verfes upon any fubject propofed to him; and thefe fo excellent, though pronounced extempore, that even a man of genius could not compofe the like without a good deal of time and pains. The Duke de Ferrara coming to Rome, to congratulate Marcellus II. upon his being raifed to the pontificate, was fo charmed with the genius of Antoniano, that he carried him to Ferrara, where he provided able mafters to inftruct him in all the fciences. From thence he was fent for by Pius IV. who made him profeffor of the belles lettres in the college at Rome. Antoniano filled this place with fo much reputation, that, on the day when he began to explain the oration *pro Marco Marcello*, he had a vaft crowd of auditors, and among thefe no lefs than 25 cardinals. He was afterwards chofen rector of the college; and after the death of Pius IV. being feized with a fpirit of devotion, he joined himfelf to Philip Neri, and accepted the office of fecretary to the facred college, offered him by Pius V. which he executed for 25 years with the reputation of an honeft and able man. He refufed a bifhopric which Gregory XIV. would have given him; but he accepted the office of fecretary to the briefs, offered him by Clement VIII. who made him his chamberlain, and afterwards a cardinal. Antoniano killed himfelf by too great fatigue: for he fpent whole nights in writing letters; which brought on a ficknefs, whereof he died, in the 63d year of his age. He wrote with fuch eafe and fluency, that he never almoft made any blot or rafure; and it is faid of him, that he preferved the flower of his virginity during his whole life.

ANTONIDES VANDER GOES (John), an eminent Dutch poet, born at Goes in Zealand, the 3d of April 1647. His parents were Anabaptifts, people of good character, but of low circumftances. They went to live at Amfterdam when Antonides was about four years old; and, in the ninth year of his age, he began his ftudies, under the direction of Hadrian Junius and James Cocceius. Antonides took great pleafure in reading the Latin poets, and carefully compared them with Grotius, Heinfius, &c. By this means he acquired a tafte for poetry, and enriched his mind with noble ideas. He firft attempted to tranflate fome pieces of Ovid, Horace, and other ancients; and, having formed his tafte on thefe excellent models, he at length undertook one of the moft difficult tafks in poetry, to write a tragedy: this was intitled *Trazil*, or *The invafion of China*. Antonides, however, was fo modeft, as not to permit it to be publifhed. Vondel, who was then engaged in a dramatic piece, which was taken alfo from fome event that happened in China, read Antonides's tragedy; and was fo well pleafed with it, that he declared, if the author would not print it, he fhould take fome paffages out of it, and make ufe of them in his own tragedy. He accordingly did fo; and it was reckoned much to the honour of Antonides, to have written what might be adopted by fo great a poet as Vondel was acknowledged to be by all good judges. Upon the conclufion of the peace between Great Britain and Holland, in the year 1697, Antonides wrote a piece intitled *Bellona aan band*, i. e. "Bellona chained; a very elegant poem, confifting of feveral hundred verfes. He next wrote an ingenious heroic poem, which he intitled, *The River Y*. (the river on which Amfterdam is built).

Antonides's parents had bred him up an apothecary: but his remarkable genius for poetry foon gained him the efteem and friendfhip of feveral perfons of diftinction; and particularly of Mr Buifero, one of the lords of the admiralty at Amfterdam, and a great lover of poetry, who fent him at his expence to purfue his ftudies at Leyden, where he remained till he took his degree of doctor of phyfic, and then his patron gave him a place in the admiralty. In 1678, Antonides married Sufanna Bermans, a minifter's daughter, who had alfo a talent for poetry. His marriage was celebrated by feveral eminent poets, particularly by the famous Peter Francius, profeffor of eloquence, who compofed fome Latin verfes on the occafion. After marriage, he did not much indulge his poetic genius; and within a few years he fell into a confumption, of which he died on the 18th September 1684, being then but thirty-feven years and a few months old. He is efteemed the moft eminent Dutch poet after Vondel. His works have been printed feveral times, having been collected by father Anthony Tanfz. The laft edition was printed by Nicholas Ten Hoom, at Amfterdam, in the year 1714, in 4to, under the direction of David Van Hoogftraaten, one of the mafters of the Latin fchool of that city, who added to it alfo the life of the poet.

ANTONINUS PIUS, the Roman emperor, was born at Lanuvium in Italy, A. C. 86, of a family originally from Nifmes in Languedoc. His character was in all refpects one of the nobleft that can be imagined; and he had the title of *Pius* given him by the fenate. We have no regular account of the tranfactions of his reign, fince Capitolinus has written in a very confufed manner; and we have only an abridgment of Dion Caffius's hiftory by Xiphilin now remaining. He managed the public revenues with great frugality, yet was extremely generous; was fond of peace, and in war preferred the reputation of juftice to all the advantages which might be gained by victory. He was more intent upon preferving the bounds of his empire than extending them; and he often made ufe of Scipio's expreffion, That he chofe rather to fave one citizen than kill a thoufand enemies. By this conduct he made himfelf univerfally efteemed and revered in that age, and admired by pofterity. This great and good emperor died in 161, aged 75 years, having reigned 23.

ANTONINUS PHILOSOPHUS (Marcus Aurelius), the Roman emperor, born at Rome, the 26th of April, in the 121ft year of the Chriftian æra. He was called by feveral names till he was admitted into the Aurelian

lian family, when he took that of Marcus Aurelius Antoninus. Hadrian, upon the death of Cejonius Commodus, turned his eyes upon Marcus Aurelius; but, as he was not then 18 years of age, and consequently too young for so important a station, he fixed upon Antoninus Pius, whom he adopted, upon condition that he should likewise adopt Marcus Aurelius. The year after this adoption, Hadrian appointed him quæstor, though he had not yet attained the age prescribed by the laws. After the death of Hadrian, Aurelius married Faustina, the daughter of Antoninus Pius, by whom he had several children. In the year 139, he was invested with new honours by the emperor Pius, in which he behaved in such a manner as endeared him to that prince and the whole people.

Upon the death of Pius, which happened in the year 161, he was obliged by the senate to take upon him the government; in the management of which he took Lucius Verus as his colleague. Dion Cassius says, that the reason of doing this was, that he might have leisure to pursue his studies, and on account of his ill state of health; Lucius being of a strong vigorous constitution, and consequently more fit for the fatigues of war. The same day he took upon him the name of Antoninus, which he gave likewise to Verus his colleague, and betrothed his daughter Lucilla to him. The two emperors went afterwards to the camp; where, after having performed the funeral rites of Pius, they pronounced each of them a panegyric to his memory. They discharged the government in a very amicable manner. It is said that, soon after Antoninus had performed the apotheosis of Pius, petitions were presented to him by the pagan priests, philosophers, and governors of provinces, in order to excite him to persecute the Christians; which he rejected with indignation, and interposed his authority for their protection, by writing a letter to the common assembly of Asia, then held at Ephesus (A). The happiness which the empire began to enjoy under these two emperors was interrupted, in the year 162, by a dreadful inundation of the Tiber, which destroyed a vast number of cattle, and occasioned a famine at Rome. This calamity was followed by the Parthian war; and at the same time the Catti ravaged Germany and Rhætia. Lucius Verus went in person to oppose the Parthians; and Antoninus continued at Rome, where his presence was necessary.

During this war with the Parthians, about the year 163 or 164, Antoninus sent his daughter Lucilla to Verus, she having been betrothed to him in marriage, and attended her as far as Brundusium: he intended to have conducted her to Syria; but it having been insinuated by some persons, that his design of going into the east was to claim the honour of having finished the Parthian war, he returned to Rome. The Romans having gained a victory over the Parthians, who were obliged to abandon Mesopotamia, the two emperors triumphed over them at Rome in the year 166; and were honoured with the title of *Fathers of their country*. This year was fatal, on account of a terrible pestilence which spread itself over the whole world, and a famine under which Rome laboured: it was likewise in this year that the Marcomanni, and many other people of Germany, took up arms against the Romans; but the two emperors havidg marched in person against them, obliged the Germans to sue for peace. The war, however, was renewed the year following, and the two emperors marched again in person; but Lucius Verus was seized with an apoplectic fit, and died at Altinum. The Romans were now defeated with great slaughter; and the emperor, not choosing to burden his subjects with new taxes, exposed to public sale the furniture of the palace, the gold and silver plate belonging to the crown, and his wife's rich garments embroidered with gold, and a curious collection of pearls, which Adrian had purchased during his long progress thro' the provinces of the empire, and was called *Adrian's cabinet*.

In the year 170, Antoninus made vast preparations against the Germans, and carried on the war with great vigour. During this war, in 174, a very extraordinary event is said to have happened, which, according to Dion Cassius, was as follows: Antoninus's army being blocked up by the Quadi, in a very disadvantageous place, where there was no possibility of procuring water; in this situation, being worn out with fatigue and wounds, oppressed with heat and thirst, and incapable of retiring or engaging the enemy, in an instant the sky was covered with clouds, and there fell a vast quantity of rain: the Roman army were about to quench their thirst, when the enemy came upon them with such fury, that they must certainly have been defeated, had it not been for a shower of hail, accompanied with a storm of thunder and lightning, which fell upon the enemy, without the least annoyance to the Romans, who by this means gained the victory (B). In 175, Antoninus made a treaty with several nations of Germany. Soon after, Avidius Cassius, governor of Syria, revolted from the emperor: this insurrection, however, was put an end to by the death of Cassius, who was killed by a centurion named *Anthony*. Antoninus behaved with great lenity towards those who had been engaged in Cassius's party:

(A) Eusebius has preserved this letter, Hist. Eccles. lib. iv. cap. 13. but he falsely ascribes it to Antoninus Pius, whereas it was wrote by Marcus Antoninus, as Valerius makes it appear in his annotations on Eusebius.

(B) The pagans as well as Christians, according to Mr. Tillemont (p. 621. art. xvi.), have acknowledged the truth of this prodigy, but have greatly differed as to the cause of such a miraculous event; the former ascribing it, some to one magician and some to another: In Antoninus's Pillar, the glory is ascribed to Jupiter the god of rain and thunder. But the Christians affirmed, that God granted this favour at the prayer of the Christian soldiers in the Roman army, who are said to have composed the twelfth or Melitene legion; and, as a mark of distinction, we are told that they received the title of the *Thundering Legion*, from Antoninus (Euseb. Eccles. Hist. lib. v. cap. 5). Mr Moyle, in the letters published in the second volume of his works, has endeavoured to explode this story of the Thundering Legion; which occasioned Mr Whiston to publish an answer, in 1726, intitled, *Of the Thundering Legion; or, Of the miraculous deliverance of Marcus Antoninus, and his army, upon the prayers of the Christians.*

 ty: he would not put to death, nor imprison, nor even sit in judgment himself upon any of the senators engaged in this revolt; but he referred them to the senate, fixing a day for their appearance, as if it had been only a civil affair. He wrote also to the senate, desiring them to act with indulgence rather than severity; not to shed the blood of any senator or person of quality, or of any other person whatsoever, but to allow this honour to his reign, that, even under the misfortune of a rebellion, none had lost their lives, except in the first heat of the tumult. In 176, Antoninus visited Syria and Egypt: the kings of those countries, and ambassadors also from Parthia, came to visit him. He staid several days at Smyrna; and, after he had settled the affairs of the east, went to Athens, on which city he conferred several honours, and appointed public professors there. From thence he returned to Rome with his son Commodus, whom he chose consul for the year following, though he was then but 16 years of age, having obtained a dispensation for that purpose. On the 27th of September, the same year, he gave him the title of *Imperator;* and on the 23d of December, he entered Rome in triumph, with Commodus, on account of the victories gained over the Germans. Dion Cassius tells us, that he remitted all the debts which were due to himself and the public treasury during 46 years, from the time that Hadrian had granted the same favour, and burnt all the writings relating to those debts. He applied himself likewise to correct many enormities, and introduced several excellent regulations. In the year 179, he left Rome with his son Commodus, in order to go against the Marcomanni, and other barbarous nations; and the year following gained a considerable victory over them, and would, in all probability, have entirely subdued them in a very short time, had he not been taken with an illness, which carried him off on the 17th of March 180, in the 59th year of his age, and 19th of his reign. The whole empire regretted the loss of so valuable a prince, and paid the greatest regard to his memory: he was ranked amongst the gods, and almost every person had a statue of him in their houses. His book of Meditations has been much admired by the best judges.

ANTONINE's Column. See COLUMN.

ANTONINUS's Wall, the name of the third rampart or defence that had been built or repaired by the Romans against the incursions of the North Britons. It is called by the people in the neighbourhood, *Graham's Dyke;* from the notion that one Graham, or Grimus, first made a breach in it after the retreat of the Romans out of Britain. The first barrier erected by the Romans was the chain of forts made by Agricola* from the frith of Forth to that of Clyde, in the year 81, to protect his conquests from the inroads of the Caledonians. The second was the vallum, or dyke, flung up by Adrian † in the year 121. It terminated on the western side of the kingdom, at *Axelodunum,* or *Brugh,* on the Solway sands; and was supposed to have reached no further than *Pons Ælii,* or *Newcastle,* on the eastern. But from an inscription lately discovered, it appears to have extended as far as the wall of Severus.‡ This rampart of Adrian's was situated much further south than Agricola's chain; the country to the north having been either, according to some authors, recovered by the native Britons after the departure of Agricola; or, according to others, voluntarily slighted by Adrian. However, this work of Adrian's did not long continue to be the extreme boundary of the Roman territories to the north in Britain. For Antoninus Pius, the adopted son and immediate successor of Adrian, having, by his lieutenant Lollius Urbicus, recovered the country once conquered by Agricola, commanded another rampart to be erected between the friths of Forth and Clyde, in the tract where Agricola had formerly built his chain of forts. The great number of inscriptions which have been found in or near the ruins of this wall, or rampart to the honour of Antoninus Pius, leave us no room to doubt its having been built by his direction and command. If the fragment of a Roman pillar with an inscription, now in the college library of Edinburgh, belonged to this work, as it is generally supposed to have done, it fixes the date of its execution to the third consulship of Antoninus, which was A. D. 140, only 20 years after that of Adrian, of which this seems to have been an imitation. This wall or rampart, as some imagine, reached from Caer-ridden on the frith of Forth to Old Kirkpatrick on the Clyde; or, as others think, from Kinniel on the east to Dunglass on the west. These different suppositions hardly make a mile of difference in the length of this work, which, from several actual mensurations, appears to have been 37 English or 40 Roman miles. Capitolinus, in his life of Antoninus Pius, directly affirms, that the wall which that emperor built in Britain was of turf. This in the main is unquestionably true; though it is evident (from the vestiges of it still remaining, which not very many years ago were dug up and examined for near a mile together) that the foundation was of stone. Mr Camden also tells us, from the papers of one Mr Anthony Pont, that the principal rampart was faced with square stone, to prevent the earth from falling into the ditch. The chief parts of this work were as follows: 1. A broad and deep ditch, whose dimensions cannot now be discovered with certainty and exactness, tho' Mr Pont says it was 12 feet wide. 2. The principal wall or rampart was about 12 feet thick at the foundation, but its original height cannot now be determined. This wall was situated on the south brink of the ditch. 3. A military way on the south side of the principal wall, well paved, and raised a little above the level of the ground. This work, as well as that of Adrian, was defended by garrisons placed in forts and stations along the line of it. The number of these forts or stations, whose vestiges were visible in Mr Pont's time, were 18, situated at about the distance of two miles from each other. In the intervals between the forts, there were turrets or watch-towers. But the number of these, and their distance from each other, cannot now be discovered.

* See *Agricola.*

† See *Adrian.*

‡ See *Severus.*

It is not a little surprising, that though it is now more than 1600 years since this work was finished, and more than 1300 since it was slighted, we can yet discover, from authentic monuments, which are still remaining, by what particular bodies of Roman troops almost every part of it was executed. This discovery is made from inscriptions upon stones, which were originally built into the face of the wall, and have been found in or near its ruins, and are carefully preserved. The number of stones with inscriptions of this kind now extant, is 11: of which six may be seen at one view in in the college of Glaſgow, one in the college of Aberdeen, one in the college of Edinburgh, one in the collection of Baron Clerk, one at Cochnoch-houſe, and one at Calder-houſe. From theſe inſcriptions it appears in general, that this great work was executed by the ſecond legion, the vexillations of the ſixth legion and of the twentieth legion, and one cohort of auxiliaries. If theſe corps were all complete, they would make in all a body of 7800 men. Some of theſe inſcriptions have ſuffered greatly by the injuries of time and other accidents; ſo that we cannot diſcover from them with abſolute certainty, how many paces of this work were executed by each of theſe bodies of troops. The ſum of the certain and probable information contained in theſe inſcriptions, as it is collected by the learned and illuſtrious Mr Horſley, ſtands thus:

	Paces.
The ſecond legion built - -	11,603
The vexillation of the ſixth legion -	7,411
The vexillation of the twentieth legion -	7,801
All certain - -	26,815
The vexillation of the twentieth legion, the monuments certain, and the number probable	3,411
The ſame vexillation, on a plain monument, no number viſible, ſuppoſed - -	3,500
The ſixth legion, a monument, but no number, ſuppoſed - - -	3,000
Cohors prima Cugernorum - -	3,000
Total	39,726

or 39 miles 726 paces, nearly the whole length of the wall. It would have been both uſeful and agreeable to have known how long time theſe troops were employed in the execution of this great work. But of this we have no information. Neither do we know what particular bodies of troops were in garriſon in the ſeveral forts and ſtations along the line of this wall, becauſe theſe garriſons were withdrawn before the *Notitia Imperii* was written.

Though we cannot diſcover exactly how many years this wall of the emperor Antoninus continued to be the boundary of the Roman territories in Britain, yet we know with certainty that it was not very long. For we are told by an author of undoubted credit, that, in the reign of Commodus, A. D. 180, "he had wars with ſeveral foreign nations, but none ſo dangerous as that of Britain. For the people of the iſland, having paſſed the wall which divided them from the Romans, attacked them, and cut them in pieces."

Dio. l. 72. p. 820.

ANTONIO (Nicholas), knight of the order of St James and canon of Seville, did great honour to the Spaniſh nation by his Bibliotheque of their writers. He was born at Seville in 1617, being the ſon of a gentleman whom king Philip IV. made preſident of the admiralty eſtabliſhed in that city in 1626. After having gone through a courſe of philoſophy and divinity in his own country, he went to ſtudy law at Salamanca; where he cloſely attended the lectures of Franciſco Ramos del Manzano, afterwards counſellor to the king and preceptor to Charles II. Upon his return to Seville, after he had finiſhed his law-ſtudies at Salamanca, he ſhut himſelf up in the royal monaſtery of Benedictines, where he employed himſelf ſeveral years in writing his *Bibliotheca Hiſpanica*, having the uſe of the books of Bennet de la Sana abbot of that monaſtery and dean of the faculty of divinity at Salamanca. In the year 1659, he was ſent to Rome by king Philip IV. in the character of agent-general from this prince: he had alſo particular commiſſions from the inquiſition of Spain, the viceroys of Naples and Sicily, and the governor of Milan, to negociate their affairs at Rome. The cardinal of Arragon procured him, from Pope Alexander VII. a canonry in the church of Seville, the income whereof he employed in charity and purchaſing of books: he had above 30,000 volumes in his library. By this help, joined to continual labour and indefatigable application, he was at laſt enabled to finiſh his Bibliotheca Hiſpanica, in four volumes in folio, two of which he publiſhed at Rome in the year 1672. The work conſiſts of two parts; the one containing the Spaniſh writers who flouriſhed before the 15th century, and the other thoſe ſince the end of that century. After the publication of theſe two volumes, he was recalled to Madrid by king Charles II. to take upon him the office of counſellor to the cruſade; which he diſcharged with great integrity till his death, which happened in 1684. He left nothing at his death but his vaſt library, which he had brought from Rome to Madrid; and his two brothers and nephews being unable to publiſh the remaining volumes of his Bibliotheca, ſent them to Cardinal d'Aguiſne, who paid the charge of the impreſſion, and committed the care thereof to Monſieur Marti, his librarian, who added notes to them in the name of the Cardinal.

Antonio (St), one of the Cape de Verd iſlands, lying in E. Long. 0. 26. N. Lat. 18. 10. It is ſeparated from St Vincent's by a clear navigable channel two leagues in breadth. On the north ſide, it has a good road for ſhipping, with a collection of freſh water riſing from ſprings, which, however, ſcarcely merits the name of a pond. The iſland ſtretches from north-eaſt to ſouth-weſt, and is filled with mountains; one of which is of ſo extraordinary a height, as to be compared with the Peak of Teneriffe: Its top is conſtantly covered with ſnow, and, notwithſtanding the clearneſs of the ſky, is generally hid in clouds. Here are produced a variety of fruits; oranges, lemons, palms, melons, &c. and ſome ſugar-canes. The potatoes and melons are particularly excellent, and are much ſought after by mariners. But, notwithſtanding all this plenty, the inhabitants live in the moſt wretched poverty. They are in number about 500, chiefly negroes, under the protection of the Portugueſe, whoſe language they ſpeak, and imitate their manners. To the north-weſt ſtands a village, containing about 20 huts, and at leaſt 50 families, under the direction of a governor, or, as they call him, a *captain*, a prieſt, and a ſchoolmaſter.

Antonio (St), a Dutch fort in Axim, on the gold coaſt of Africa. It ſtands on a high rock, which projects into the ſea in form of a peninſula; and is ſo environed by rocks and dangerous ſhoals, as to be inacceſſible to an enemy but by land, where it is fortified by a parapet, draw-bridge, and two batteries of heavy canon. Beſides this it has a battery towards the ſea. The three batteries conſiſt of 24 canon. Its form is triangular; the building is neat, ſtrong, and commodious for the extent, that being but ſmall, on account of the narrowneſs of the rock on which it is built. The garriſon is uſually compoſed of 25 white men, and an equal number of negroes, under the command of a ſerjeant.

Antonius. jeant. It is maintained at the expence of the Weſt-India Company; and, when well ſtored with proviſions, is capable of making a long defence againſt any number of negroes. It is, however, as well as all other forts on this coaſt, liable to inconveniences from the heavy and continual rains, which damage the walls, and render frequent reparations neceſſary. This obliges the Dutch always to keep ready a quantity of lime or cement made of calcined oyſter-ſhells, of which the coaſt produces great numbers.—This ſettlement was firſt founded by the Portugueſe during the reign of Emanual. They fixed at firſt upon a ſmall point; where, finding themſelves inſecure, they built the fort where it now ſtands. They were driven out by the Dutch in 1642; and, upon the concluſion of a peace with the States-general, the fort remained by treaty in the hands of the Dutch Weſt-India Company, who have kept poſſeſſion of it ever ſince.

ANTONIUS (Marcus), a famous Roman orator. While he filled the office of prætor, Sicily fell to his lot, and he cleared the ſeas of the pirates which infeſted that coaſt. He was made conſul with A. Poſthumius Albinus, in the year of Rome 653; when he oppoſed the turbulent deſigns of Sextus Titus, tribune of the people, with great reſolution and ſucceſs. Some time after, he was made governor of Cilicia, in quality of proconſul; where he performed ſo many great exploits, that he obtained the honour of a triumph. We cannot omit obſerving, that, in order to improve his great talent for eloquence, he became a ſcholar to the greateſt men at Rhodes and Athens, in his way to Cilicia, and when on his return to Rome. Soon after he was appointed cenſor; which office he diſcharged with great reputation, having carried his cauſe before the people, againſt Marcus Duronius, who had preferred an accuſation of bribery againſt him, in revenge for Antonius's having eraſed his name out of the liſt of ſenators, which this wiſe cenſor had done, becauſe Duronious, when tribune of the people, had abrogated a law which reſtrained immoderate expence in feaſts. He was one of the greateſt orators ever known at Rome; and it was owing to him, according to the teſtimony of Cicero, that Rome might boaſt herſelf a rival even to Greece itſelf in the art of eloquence. He defended, amongſt many others, Marcus Aquilius; and moved the judges in ſo ſenſible a manner, by the tears he ſhed, and the ſcars he ſhowed upon the breaſt of his client, that he carried his cauſe. He never would publiſh any of his pleadings, that he might not, as he ſaid, be proved to ſay in one cauſe, what might be contrary to what he ſhould advance in another. He affected to be a man of no learning. His modeſty, and many other qualifications, rendered him no leſs dear to many perſons of diſtinction, than his eloquence made him univerſally admired. He was unfortunately killed during thoſe bloody confuſions raiſed at Rome by Marius and Cinna. He was diſcovered in the place where he hid himſelf, and ſoldiers were ſent to diſpatch him; but his manner of addreſſig them had ſuch an effect, that none but he who commanded them, and had not heard his diſcourſe, had the cruelty to kill him. His head was expoſed before the roſtra, a place which he had adorned with his triumphal ſpoils. This happened 90 years before the Chriſtian æra.

Antonius (Marcus) the triumvir, grandſon to the former, was very handſome in his youth; for which reaſon he was greatly beloved by Curio a ſenator, who, by carrying him about in all his debaucheries, made him contract ſuch heavy debts, that his own father forbad him his houſe. Curio, however, was ſo generous as to bail him for 250 talents. When the civil war broke out, Curio took Cæſar's party, and prevailed with Antonius to do the ſame; for which he was made a tribune of the people, and in that office did Cæſar great ſervice. Cæſar, having made himſelf maſter of Rome, gave Antonius the government of Italy: at the battle of Pharſalia, Cæſar confided ſo much in him, that he gave him the command of the left wing of his army, whilſt he himſelf led the right. After Cæſar was made dictator, he made Antonius general of the horſe, though he had never been prætor; in which command he exerted his power with the utmoſt violence. He was made conſul, when Cæſar enjoyed that honour for the fifth time, the laſt year of that uſurper's life. On Cæſar's death he harrangued the populace with great art, and raiſed their fury againſt his murderers; flattering himſelf that he ſhould eaſily get into the place which Cæſar had filled: but his haughty behaviour made him loſe all the advantages his affected concern for Cæſar had gained him. His ill treatment of Octavius, and quarrel with him, produced another civil war; which ended in an accommodation between him, Octavius, and Lepidus, fatal to the peace of Rome. They agreed to ſhare the ſupreme power among them; and many of the moſt illuſtrious Romans were ſacrificed by proſcription to cement this bloody league, which is known by the name of the *Second Triumvirate*. But the triumvirs were too ambitious, and hated one another too much, to be long united. Antonius went into Aſia to raiſe money for his ſoldiers: during his abſence, Fulvia his wife quarrelled with Octavius. When Antonius was in Aſia, indulging himſelf in all manner of luxury, the famous Cleopatra inſpired him with the moſt violent paſſion. Hearing of the quarrel between Fulvia and Octavius, and finding Octavius was become publicly his enemy, Antonius entered into a confederacy with Sextus Pompeius, who was ſtill maſter of Sicily. He then went into Italy, in order to fight Octavius; but Fulvia, who had been the author and promoter of this war, dying, Octavius and Antonius came to an agreement. One of the conditions of this new peace was, that they ſhould together attack Pompey, though the former had lately made an alliance with him. Antonius then married Octavia, ſiſter to Octavius, as a pledge of their renewed friendſhip; but returned ſoon after to his beloved Cleopatra, and again lived with her in Alexandria. Octavius took hold of this pretence to inveigh againſt him, and begin the war again. At laſt they engaged in a ſea-fight at Actium, in which Octavius gained a complete victory; which was followed by the deaths both of Antonius and Cleopatra. The infatuated Antonius fell upon his own ſword; and Cleopatra ſtung herſelf to death with an aſp, as was ſuppoſed, to avoid gracing the victor's triumph at Rome.

Antonius. Antonomaſia.

ANTONOMASIA, a form of ſpeech, in which, for a proper name, is put the name of ſome dignity, office, profeſſion, ſcience, or trade; or when a proper name is put in the room of an appellative. Thus a king is called his *majeſty*; a nobleman, his *lordſhip*. We ſay the *philoſopher* inſtead of Ariſtotle, and the *ora-*

tor for Cicero: Thus a man is called by the name of his country, a *German*, an *Italian*; and a grave man is called a *Cato*, and a wise man a *Solomon*.

ANTOSIANDRIANS, a sect of rigid Lutherans, who oppose the doctrine of Osiander relating to justification. These are otherwise denominated *Osiandromastiges*.—The Antosiandrians deny that man is made just, with that justice wherewith God himself is just; that is, they assert, that he is not made essentially, but only imputatively, just; or, that he is not really made just, but only pronounced so.

ANTRIM, the most northerly county of Ireland. It is bounded by that of Down on the south-east, that of Londonderry on the west, from which it is separated by the river Bann, part of Armagh on the south, St George's channel on the east, and the Deucaledonian ocean on the north. Its greatest length is about 46 miles, its greatest breadth about 27; and the number of acres it contains, plantation-measure, are computed at 383,000. Though the country is much incumbered with bogs and marshes, yet it enjoys a pretty good air, and is well peopled, chiefly with protestants. Where it is free from bogs the soil is fruitful. It sends two members for the shire, and two for each of the following towns, viz. Lisburn, Belfast, Antrim, and Randalstown.

Certain narrow valleys, called *glyns*, beginning here, and running a great way along the coast, belonged formerly to the Bissets, noblemen of Scotland, who having been obliged to quit that country for having assassinated Patrick earl of Athol upon a private quarrel, came hither, and had a great estate bestowed upon them by Henry III. of England; of which, in the reign of Edward II. a part was forfeited by the rebellion of Hugh, then chief of the family. Another tract near this, called the *Rowte*, belonged anciently to the Macguillers, but now to the M'Donnels earls of Antrim.

Upon the coast of this country are the promontories called by Ptolemy, *Robogdium*, *Vennicinium*, and *Boræum*, now *Fair Foreland*, *Ramshead*, and *St Helen's-head*. The river also, styled by the same author *Vidua*, and now *Crodagh*, runs through this county.—Here also is the remarkable natural curiosity called the GIANT's-*Causeway*; for a particular description of which see that article.

ANTRIM, the capital town of the county of Antrim, in Ireland, seated at the north end of the lake Lough-Neagh, about six miles from the mouth of the bay, having a good road before it, with a pier near the place, within which vessels lie dry at low water. It was anciently a borough of great consequence, as appears from the mayor's being admiral of a considerable extent of coast, as well in Down as in this county; the corporation enjoying the customs paid by all vessels within those bounds, the creeks of Bangor and Belfast only excepted. This grant, however, the crown repurchased, and thereupon transferred the custom-house to Belfast, to which town it is now much inferior as well in size as in trade. It is, however, still a place of note, and sends two members to the house of commons. It gives the title of *earl* to the noble family of M'Donnell.—At Antrim is a seat, with noble demesnes, and beautiful and highly cultivated lands, of the Earl of Massareene.—It is but a poor place, 13 miles west of Carrickfergus. W. Long. 6. 26. N. Lat. 54. 45. It sends two members to parliament.

ANTRUM, among anatomists, a term used to denote several cavities of the body: as the *antrum highmorianum*, or that in the maxillary or jaw bone; *antrum pylori*, or that at the bottom of the pylorus, &c.

ANTWERP, a city of the duchy of Brabant, in the Austrian Netherlands, capital of the marquisate of Antwerp, otherwise called the *marquisate of the holy Roman empire*, situated in E. Long. 4. 15. N. Lat. 51. 12. It lies in a low marshy ground on the Scheld. 24 miles from Brussels to the north. It is the third city in rank in Brabant, large and well built, containing 22 squares, and above 200 streets, all straight and broad, especially that called the *Mere*, in which six coaches can go abreast. Most of the houses are of free-stone, and have an air of antiquity, being high, with courts before and gardens behind. At the head of the Mere is a crucifix of brass thirty-three feet high. The cathedral dedicated to the Virgin Mary, the stadt-house, and the exchange, are magnificent structures: the latter is the first building of that kind in Europe, and on its model the exchanges of London and Amsterdam are built. Its pillars are all of blue marble, and carved, but all in a different manner. The exchange cost the city 300,000 crowns. Antwerp, towards the end of the fifteenth century, was one of the most celebrated towns that ever existed. The Scheld, on which it stands, being 20 feet at low water, and rising 20 feet more at flood, ships of the greatest burden came up to the keys, as in the river Thames at London; but when the United Provinces formed themselves into a free state, after having shaken off the yoke of Spain, they got the entire command of the navigation of the Scheld; which ruined the trade of Antwerp, and transferred it to Amsterdam. This made the inhabitants turn their heads to painting, jewelling, and banking, which they have continued to this day with great success and reputation: for at Antwerp bills of exchange may be negociated for any sum to any part of Europe; and in the time of Queen Anne's wars, two brothers of the name of De Koning, paid the one the army of France, and the other that of the confederates. Besides, here is a fine manufacture of tapestry and lace; and, for the promoting of trade, an insurance-company has been erected. This city is the see of a bishop, who, as abbot of St Bernard, is the second prelate in Brabant. The bishopric is of great extent, and the cathedral a most noble pile, with one of the finest steeples in the world. The emperor Charles V. when he made his entry into Antwerp, said it ought to be put in a case, and showed only once a-year for a rarity. The house of the hanse-towns, built when the city was in its flourishing condition, is a stately building, with magazines above for dry goods, and cellars below for wet, and in the middle story were 300 lodging-rooms for merchants; but now it is turned to a horse-barrack. There is a market here called the *Friday's market*, because it is held every Friday, where all sorts of household goods, pictures, and jewels, are sold by auction. No city in the Netherlands has so many and so fine churches as this. Many of them, particularly the cathedral and Jesuits church, are adorned with paintings, by Sir Peter Paul Rubens, who was a native

Antwerp.

tive of this city; and by Quintin Masseys, who is said to have been a blacksmith; but having fallen in love with a painter's daughter, and been told by her father, when he asked her of him in marriage, that he would have none but a painter for his son-in-law, he went to Italy to study painting, and, in a few years, returned so eminent in his new profession, that he found no difficulty in obtaining the father's consent. He is interred at the entry of the cathedral, where his effigy is put up, with an inscription, signifying, that conjugal love made an Apelles of a blacksmith. The abovementioned Jesuits church is extremely magnificent, and the chapel of the Virgin, joining to it, still more so. Among the cloisters the most remarkable are, the noble and rich abbey of St Michael, on the banks of the Scheld, the apartments of which are truly royal, and in which all sovereign princes that pass this way actually lodge; and the English nunnery, of the order of St Teresa, the nuns of which never wear linen, nor eat flesh, and lie upon straw: the grates of the convent are so dismal, that it looks like a prison. As to the fortifications of the city, it is environed with a fine wall, planted with rows of trees on each side, with walks between broad enough for two coaches to go abreast, being also defended by a very strong, large, regular citadel, in form of a pentagon, erected by the Duke of Alva in 1568, which commands the town and the neighbouring country. The magistracy of this city is chosen only out of the seven patrician families; and consists of two burgomasters and 18 echevins, besides inferior magistrates. Among the privileges granted to it by its princes, there is one by which every person born in it is a citizen, though both his father and mother were foreigners.

In 1585, Antwerp underwent a remarkable siege by the Duke of Parma. It was then the most wealthy city in the Netherlands, and had long been the object of his designs; but the difficulties attending the enterprize obliged him to postpone it for a considerable time. In order to succeed, it was necessary to cut off the communication of the city with Holland, Ghent, and all places above and below Antwerp on the Scheld. To effect this, he laid siege to Liskenshouk and Tillo, places of the utmost consequence to the security and commerce of the city: both were obstinately defended; and the siege of the latter was raised, after it had been carried on for three months: however, the Duke gained several other posts on the river, where he built forts, and greatly annoyed the shipping and trade of the city. He next laid siege to Dendermonde, in order to cut off the communication with Ghent, in which he succeeded by the reduction of the town. His next attempt was on Vilvorde: this place he took by assault, and thereby cut off the communication with Brussels. Finding, however, this method of hemming in the city tedious, and ineffectual while an opening to the mouth of the river remained, he formed a design of building a bridge across the Scheld, the extremities of which were to be defended by strong forts and out-works. He began with collecting great quantities of wood at Callo and fort St Philip, where he intended the bridge should be built; but his project was for some time retarded by the Antwerpers, who broke down the dykes, overflowed the whole country, and carried of his magazines by the inundation. Not discouraged by this loss, he applied himself diligently to repair it, and with incredible expedition cut a canal from Steken to Callo, by which he carried off the waters. He then set to work upon the bridge, and finished it in seven months, without any interruption from the Zealanders. During the building of this bridge, Aldegonde, governor of Antwerp, proposed to build a fort on Couvensteyn dyke, in order to secure that important post, and then breaking down the dyke when the bridge was near finished: but he was violently opposed by certain citizens, who apprehended that their lands and villas would be destroyed by the inundation. This unseasonable opposition, with the negligence of the magistrates, who, because the markets were high, had not laid in a sufficient stock of corn, occasioned the loss of the city. However, in despite of all the Duke of Parma's precautions, the Zealanders found means to throw in a convoy of corn; but the citizens, knowing they would not run the risk of carrying it back again, so cheapened the price, that these bold traders refused ever to bring their goods again to so bad a market. The Antwerpers, having thus through avarice brought on their ruin, began in a short time to suffer by famine; they then pressed the Zealanders to attempt something for their relief, but it was now too late. While the magistrates were deliberating on some means for destroying the bridge, which they might have prevented from being ever completed, one Ginebelli, a Mantuan engineer, offered his services, undertaking at a certain expence to blow it into the air. Even in this extremity the expence was grudged: but necessity at last overcame this obstacle; Ginebelli was furnished with two large vessels, a number of small boats, and every thing necessary. He formed the two large vessels into fire-ships, which he set adrift with the stream, deceiving the enemy by means of false fires lighted up in the fleet of small boats. The train of one of the fire-ships was expended before the time expected, and she blew up with a terrible explosion, but with little damage to the bridge. The other was more successful, carrying off all the outworks, setting fire to the whole bridge, and burying above 500 soldiers in the ruins it made. The fire, however, was soon extinguished, and the bridge repaired by the Duke of Parma, while the Antwerpers were prevented by avarice from repeating the experiment; so that they were soon reduced to the greatest straits, and obliged to surrender. It is said that the city of Amsterdam had obstructed every measure for the relief of Antwerp, hoping to profit by its destruction. It was not doubted but the Protestants would forsake it as soon as it fell into the hands of an arbitrary Catholic prince; and this conjecture was soon fulfilled by the removal of many families with their effects to Amsterdam.—After the battle of Ramillies, the city of Antwerp surrendered to the Duke of Marlborough. It was taken by the French in 1746, but restored to the house of Austria at the treaty of Aix-la-Chapelle.

Anubis.

ANUBIS, a symbolical deity of the Egyptians, was regarded as the faithful companion of Osiris and of Isis. Temples and priests were consecrated to him, and his image was borne in all religious cerimonies.

Cynopolis, the present Minieh, situated in the lower Thebais, was built in honour of Anubis. The temple wherein he was worshipped no longer subsists. The priests celebrated his festivals there with great pomp, and conſecrated the dog to him as his living repreſentation. "Anubis (ſays Strabo) is the city of dogs, the captal of the Cynopolitan prefecture. Theſe animals are fed there on ſacred aliments, and religion has decreed them a worſhip." An event, however, related by Plutarch, brought them into conſiderable diſcredit with the people. Cambyſes having ſlain the god Apis, and thrown his body into a field, all animals reſpected it except the dogs, which alone eat of his fleſh. This impiety diminiſhed the popular veneration for them.

Cynopolis was not the only city which burned incenſe on the altars of Anubis. He had chapels in almoſt all the temples. On ſolemnities, his image always accompanied thoſe of Iſis and Oſiris. Rome having adopted the ceremonies of Egypt, the emperor Commodus, to celebrate the Iſiac feaſts, ſhaved his head, and himſelf carried the god Anubis. The ſtatue of this god was either of maſſive gold or gilt, as well as the attributes that accompanied them. Anubis ſignifies *gilded*. The denomination was myſterious; and the Egyptian prieſts, it would ſeem, had not given it without reaſon.

The ſignification of this emblematical deity is thus explained by Plutarch: "The circle which touches and ſeparates the two hemiſpheres, and which is the cauſe of this diviſion, receiving the name of *horizon*, is called *Anubis*. He is repreſented under the form of a dog, becauſe that animal watches day and night." St Clemens of Alexandria, who was well informed in the myſtic theology of the Egyptians, favours this explication. The two dogs, ſays he, (the two Anubis) are the ſymbols of two hemiſpheres which environ the terreſtial globe. He adds in another place: Others pretend that theſe animals, the faithful guardians of men, indicate the tropics, which guard the ſun on the ſouth and on the north like porters.

According to the former of theſe interpretations, the prieſts, regarding Anubis as the horizon, gilded his ſtatue; to mark, that this circle, receiving the firſt rays of the ſun, appears ſparkling with brightneſs on his riſing, and that at his ſetting he reflects his laſt rays upon the earth. They ſaid in their ſacred fables, that Anubis was the ſon of Oſiris, but illegitimate. In fact, he only gives to the earth a borrowed light; and cannot be eſteemed, like Horus, as the father of the day, or as the legitimate offspring of Oſiris. It may be added that the viſible horizon turning with the ſun, is his inſeparable companion.

In the latter of theſe explications, where Anubis repreſents the tropics, he is alſo the faithful guardian of Iſis and Oſiris. In fact, the courſe of the ſun and of the moon is contained between the circles wherein the ſolſtices are performed. They neither deviate to the right nor left. Theſe limits aſſigned by the Author of nature might therefore, in hieroglyphic language, be repreſented by a divinity with the head of a dog, who ſeemed to oppoſe their paſſage on the ſide of the two poles The other opinion, notwithſtanding, ſeems more natural, and to be more analogous to the ideas of the prieſts.

Upon the whole, it is reaſonable to imagine, that Anubis at firſt was only a ſymbolical image, invented by aſtronomers to give a ſenſible expreſſion of their diſcoveries; that afterwards, the people, accuſtomed to ſee it in their temples, which were the depoſitaries of ſcience, adored it as a deity; and that the prieſts favoured their ignorance by connecting it with their religion. The worſhip of Anubis introduced, that of the dog became his emblem. Almoſt all the gods of the Gentiles have originated in this manner.

ANUS, in anatomy, the lower extremity of the inteſtinum rectum, or orifice of the fundament.

ANVIL, a ſmith's utenſil, ſerving to place the work on to be hammered or forged. The face or uppermoſt ſurface of the anvil, muſt be very flat, and ſmooth, without flaws, and ſo hard that a file will not touch it. At one end there is ſometimes a pike, bickern, or beak-iron, for the rounding of hollow work. The whole is uſually mounted on a firm wooden block. Forged anvils are better than thoſe of caſt work, and the beſt have the upper part made of ſteel. Lockſmiths have a ſmaller kind of anvil called the *ſtake*, which is moveable, and placed ordinarily on their work-bench. Its uſe is for ſetting ſmall cold work ſtraight, or to cut or punch on with the cold chiſſel or cold punch.

ANXUR, (anc. geog.), a city of the Volſci, in Latium; called *Tarracina*, by the Greeks and Latins; Now *Terracina;* ſituated on an eminence (Livy, Horace, Sil. Italicus). *Anxuras*, a citizen of Anxur (Livy). And the epithet *Anxurus*, a name of Jupiter, worſhipped without a beard at Anxur (Virgil). Though others read *Axurus*, or *Axyrus*, without a razor. E. Long. 14. 5. Lat. 41. 18.

AONIDES, in mythology, one of the many appellations of the muſes; ſo called from Aonia, a part of ancient Bœotia.

AORASIA, in antiquity, the inviſibility of the gods. The word is Greek, *αορασια*, and derived from *α*, priv. and *οραω*, to ſee. The opinion of the ancients with regard to the appearance of the gods to men, was, that they never ſhowed themſelves face to face, but were known from their backs as they withdrew. Neptune aſſumed the form of Calchas to ſpeak to the two Ajaxes; but they knew him not till he turned his back to leave them, and diſcovered the god by his majeſtic ſtep as he went from them. Venus appeared to Æneas in the character of a huntreſs: but her ſon knew her not, till ſhe departed from him; her divinity was then betrayed by her radiant head, her flowing robe, and her majeſtic pace.

AORIST, among grammarians, a tenſe peculiar to the Greek language, comprehending all the tenſes; or rather, expreſſing an action in an indeterminate manner, without any regard to paſt, preſent, or future.

AORISTIA, in the ſceptic philoſophy, denotes that ſtate of the mind wherein we neither aſſert nor deny any thing poſitively, but only ſpeak of things as ſeeming or appearing to us in ſuch a manner. The aoriſtia is one of the great points or terms of ſcepticiſm, to which the philoſophers of that denomination had continual recourſe by way of explication, or ſubterfuge. Their adverſaries, the Dogmatiſts, charged them with dogmatizing, and aſſerting the principles and poſitions of their ſect to be true and certain.

AORNUS, a very high rock of India, having its name from its extraordinary height, as being above the flight of a bird. Its circuit was about 25 miles, its height 11 furlongs, and the way leading up to the top artificial and narrow. At the bottom, on one ſide, ran the river Indus: on the top was a fine plain, part of which was covered with a thick wood; the reſt arable land, with a fountain furniſhing abundance of excellent water. This rock was taken by Alexander the Great, in whoſe time there was a report that Hercules had attempted it in vain; however, according to Arrian, this report was without foundation. It is probable indeed, that it was raiſed after the place was taken, in order to magnify Alexander's exploit. While the Macedonian monarch was preparing all things neceſſary for the ſiege, an old man with his two ſons, who had long lived in a cave near the ſummit, came and offered to ſhow him a private way of aſcending. This being readily accepted, Ptolemy, with a conſiderable body of light-armed troops, was diſpatched with them, with orders in caſe they ſucceeded, to entrench themſelves ſtrongly upon the rock, in the wood to which the old man was to direct them, before they ventured to attack the Indians. Ptolemy exactly executed his orders; and gave notice, by a lighted torch ſet upon a pole, that he had got ſafely up. Upon this, Alexander gave immediate orders for a body of troops to attempt the paſſage by which the rock was commonly aſcended; but they were repulſed with great ſlaughter. He then ſent an Indian with letters to Ptolemy, deſiring him, the next time an attack was made by the common way, to fall upon the enemy behind. But in the mean time, thoſe who defended the rock attacked Ptolemy with great vigour; but were at laſt repulſed, though with much difficulty: but the next day, when Alexander renewed the attack, though Ptolemy attacked the Indians in the rear, the Macedonians were repulſed on both ſides. At laſt the king, perceiving that the ſtrength of the Indians lay in the ſtraitneſs and declivity of the way by which they were attacked, cauſed a great quantity of trees to be felled, and with them filled the cavities between the plain on which the Indians were encamped and the higheſt of his own advanced poſts. The Indians at firſt derided his undertaking; but at length perceiving the ardour with which the work was carried on, and having felt the effects of the miſſile weapons of the Macedonians, they ſent deputies to propoſe terms of capitulation. Alexander, ſuſpecting that their deſign was only to amuſe him till they made their eſcape, withdrew his guards from the avenues. As ſoon as he knew the Indians were deſcended, he, with 700 of Ptolemy's light-armed foot, took poſſeſſion of the deſerted rock, and then made a ſignal for his forces to fall upon the flying Indians. They ſetting up a loud ſhout, ſo terrified the fugitives, that numbers of them fell from the rocks and precipices, and were daſhed to pieces, while the greateſt part of the remainder were cut off in the roads.

AORTA, in anatomy, the great artery which riſes immediately from the left ventricle of the heart, and is from thence diſtributed to all parts of the body. It is divided into two grand trunks, diſtinguiſhed by the epithets *aſcending* and *deſcendiug*. See Anatomy.

AOUSTA, or Aost, a town of Italy, in Piedmont, and capital of the duchy of the ſame name, a biſhop's ſee, and ſubject to the king of Sardinia. It is remarkable for ſeveral monuments of the Romans, and for the birth of Anſelm archbiſhop of Canterbury. It is ſeated at the foot of the Alps, on the river Doria. E. Long. 7. 33. N. Lat. 45. 38.

Aousta, a territory of Piedmont, with the title of a duchy. It is a valley 30 miles in length, and extends from the paſs of St. Martin's, near the frontiers of Yvree, to St. Bernard. It abounds in paſtures, and all ſorts of fruits; the capital is of the ſame name.

AOUTA, the name of the paper-mulberry tree at Otaheite, in the South Sea, from which a cloth is manufactured, that is worn by the principal inhabitants. See the article Bark.

APACHES, a people of New Mexico, in North America. They are brave, reſolute, and warlike, fond of liberty, and the inveterate enemies of tyranny and oppreſſion. Of this diſpoſition the Spaniards had fatal experience towards the end of the laſt century, when they revolted againſt the Catholic king, maſſacred ſeveral of his officers, and committed the greateſt devaſtations. Ever ſince they have remained the allies, not the ſubjects, of the Spaniards; and the viceroy of Mexico has been obliged to maintain a more formidable garriſon, and a greater number of troops.

APÆDUSIA, denotes ignorance or unſkilfulneſs in what relates to learning and the ſciences. Hence alſo perſons uninſtructed and illiterate are called *Apædeutæ*. The term *Apædeutæ* was particularly uſed among the French in the time of Huet; when the men of wit at Paris were divded into two factions, one called by way of reproach *apædeutæ*, and the other *eruditi*. The *apædeutæ* are repreſented by Huet, as perſons who, finding themſelves either incapable or unwilling to undergo a ſevere courſe of ſtudy in order to become truly learned, conſpired to decry learning, and turn the knowledge of antiquity into ridicule, thus making a merit of their own incapacity. The *apædeutæ* in effect were the men of pleaſure; the *eruditi* the men of ſtudy. The *apædeutæ* in every thing preferred the modern writers to the ancient, to ſuperſede the neceſſity of ſtudying the latter. The *eruditi* derided the moderns, and valued themſelves wholly on their acquaintance with the ancients.

APAGOGE, in logic. See Abduction.

Apagoge, in the Athenian law, the carrying a criminal taken in the fact to the magiſtrate. If the accuſer was not able to bring him to the magiſtrate, it was uſual to take the magiſtrate along with him to the houſe where the criminal lay concealed, or defended himſelf.

Apagoge, in mathematics, is ſometimes uſed to denote a progreſs or paſſage from one propoſition to another; when the firſt having been once demonſtrated, is afterwards employed in the proving of others.

APAGOGICAL demonstration, an indirect way of proof, by ſhowing the abſurdity of the contrary.

APALACHIAN Mountains, more properly called the *Allegany Mountains*, have their ſouthern beginning near the bay of Mexico, in the latitude of 30°, extending northerly in many broken ridges, running nearly parallel to the ſea to Hudſon's river, in the latitude of about 40° North. A great part of theſe mountains is covered with rocks, ſome of which are of a ſtupendous height and bulk; the ſoil between them is generally black and ſandy, but in ſome places differently coloured, compoſed of pieces of broken rock and ſpar, of a glittering appearance, which ſeem to be indications of minerals and ores if proper ſearch was made for them. Cheſnuts and ſmall oaks are the trees that principally grow on theſe mountains, with ſome *Chinkapin** and other ſmall ſhrubs. The graſs is thin, mixed with vetch and ſmall peaſe; and in ſome places there is very little vegetable appearance.

*Fagus pumila. See *Fagus*.

The rocks of the Apalachian mountains ſeem to engroſs one-half of the ſurface. They are moſtly of a light grey colour: ſome are of a coarſe-grained marble like alabaſter; others, of a metallic luſtre: ſome pieces are in the form of ſlate, and brittle; others in lumps, and hard: and ſome appear with ſpangles, or covered over with innumerable ſmall ſhining ſpecks, like ſilver. Theſe frequently appear at the roots of trees when blown down. The different ſpars are found moſt on the higheſt and ſteepeſt parts of the hills, where there is little graſs and few trees; but the greateſt part of the ſoil between the rocks is generally a dark ſandy-coloured kind of mould, and ſhallow; yet fertile, and productive of good corn, which encourages the Tallipooſes, a clan of the Cherokee Indians, to ſettle among them in latitude 34°' and they are the only Indian nation that has a conſtant reſidence on theſe mountains.

APAMEA, or Apamia, the name of ſeveral ancient cities.

1. One of Bithynia, formerly called *Myrlea*, from Myrlus, general of the Colophonians: deſtroyed by Philip, father of Perſeus; and given to his ally Pruſius, who rebuilt it, and called it *Apamea*, from the name of his queen Apama (Strabo). Stephanus ſays, that Nicomedus Epiphanes, ſon of Pruſius, called it after his mother; and that it had its ancient name from Myrlea, an Amazon. The Romans led a colony thither (Strabo); called *Colonea Apamena* (Pliny, Appian). The gentilitious name is *Apamæus*, and *Apamenus* (Trajan in a letter to Pliny).

2. Another *Apamea*, called *Cibotos*, of Phrygia, at ſome diſtance from the Meander (Agathodæmon); but by a coin of Tiberius on the Meander. The name is from Apame, mother of Antiochus Soter, the founder, and the daughter of Artabazus (Strabo). The riſe, or at leaſt the increaſe, of Apamea, was owing to the ruins of Celenæ. The inhabitants were called *Apamienſis*, and, though inland, were worſhippers of Neptune. The reaſon, it has been conjectured, was, that they had ſuffered often from earthquakes, of which he was ſuppoſed the author. Mithridites gave an hundred talents towards the reſtoration of the city, which, it is ſaid, had likewiſe been overthrown in the time of Alexander. Their tribute money was remitted to them for five years on the ſame account under the Emperor Tiberius. The ſubterraneous paſſage of the Lycus and the other ſtreams ſhowed that the ground had many cavities; and theſe, it has been ſurmiſed, rendered the region very liable to be ſhaken.

3. A third, on the confines of Parthia and Media, ſurnamed *Raphane* (Strabo, Pliny).

4. A fourth, *Apamea*, a town in Meſene, an iſland in the Tigris (Pliny, Ammian); where a branch of the Euphrates, called the *Royal river*, falls into the Tigris (Ptolemy).

5. A fifth in Meſopotamia, on the other ſide the Euphrates, oppoſite to Zeugma on this ſide, both founded by Seleucus, and joined by a bridge, from which the latter takes its name (Pliny, Iſidor, Characenus).

6. Another *Apamea*, near *Famia*, alſo in Syria, below the confluence of the Orontes and Marſyas; a ſtrong city, and ſituated in a peninſula, formed by the Orontes and a lake. "It was here (ſays Strabo) that the Seleucidæ had eſtabliſhed the ſchool and nurſery of their cavalry." The ſoil of the neighbourhood, abounding in paſturage, fed no leſs than thirty thouſand mares, three hundred ſtalions, and five hundred elephants; inſtead of which the marſhes of Famia at preſent ſcarcely afford a few buffaloes and ſheep. To the veteran ſoldiers of Alexander, who here repoſed after their victories, have ſucceeded wretched peaſants, who live in perpetual dread of the oppreſſions of the Turks and the inroads of the Arabs.

Apamea was alſo the ancient name of *Pella*, in the Decapolis.

APANAGE, or Appennage, in the French cuſtoms, lands aſſigned by a ſovereign for the ſubſiſtence of his younger ſons, which revert to the crown upon the failure of male iſſue in that branch to which the lands are granted.

APANOMIA, a town of Santorin, an iſland in the Mediterranean ſea, called in this part, by ſome, the *Sea of Candia*: it has a ſpacious harbour, in the form of a half-moon; but the bottom is ſo deep, that ſhips cannot anchor there, E. Long. 25. 59. N. Lat. 36. 18.

APANTHROPY, in medicine, denotes a love of ſolitude, and averſion for the company of mankind. Apanthropy is by ſome reckoned among the ſymptoms, by others among the ſpecies or degrees, of melancholy; and alſo paſſes for an ill indication in leucophlegmatic caſes.

APARINE, in botany, a ſynonime of the utricularia and ſeveral other plants.

APARITHMESIS, in rhetoric, denotes the anſwer to the protaſis or propoſition itſelf. Thus, if the protaſis be, *Appellandi tempus non erat*, —the aparithmeſis is, *At tecum anno plus vixi*.

APARTISMENUS, in the ancient poetry, an appellation given to a verſe, which comprehended an entire ſenſe or ſentence in itſelf. This is ſometimes alſo written, *appartemenus*, i. e. ſuſpended, as not needing any following verſe.

APATHY, among the ancient philoſophers, implied an utter privation of paſſion, and an inſenſibility of pain. The word is compounded of α priv. and πάθος, affection. The Stoics affected an entire apathy: they conſidered it as the higheſt wiſdom to enjoy a perfect calmneſs or tranquillity of mind, incapable of being ruffled by either pleaſure or pain. In the firſt ages of the church, the Chriſtians adopted the term *apathy* to expreſs a contempt of all earthly concerns; a ſtate of mortification, ſuch as the goſpel preſcribes. Clemens Alexandrinus, in particular, brought it exceedingly in vogue; thinking hereby to draw the philoſophers to Chriſtianity, who aſpired after ſuch a ſublime pitch of virtue. Quietiſm is only apathy diſguiſed under the appearance of devotion.

APATURIA, in antiquity, a ſolemn feaſt celebrated by the Athenians in honour of Bacchus. The word is uſually derived from ἀπάτη, *fraud*. It is ſaid to have been inſtituted in memory of a fraudulent victory obtained by Melanthus, King of Athens, over Xanthus king

king of Bœotia, in a single combat, which they agreed upon, to put an end to a debate between them relating to the frontiers of their countries. Hence Budæus calls it *festum deceptionis*, "the feast of deceit."

Other authors give a different etymology of this feast: They tell us, that the young Athenians were not admitted into the tribes on the third day of the apaturia, till their fathers had first sworn, that they were their own children; and that, till that time, they were supposed, in some measure, to be without fathers, *απατορες*; whence the feast, say they, took its name. Xenophon, on the other hand, informs us, that the relations and friends met on this occasion, and joined with the fathers of the young people who were to be received into the tribes; and that from this assembly the feast took its name: that in *απατερια*, the *α*, far from being a privative, being here a conjunctive, signifies the same thing with *ομυ*, *together*. This feast lasted four days: the first day, those of the same tribe made merry together; and this they called *δορπια*. The second day, which they called *αναρρυσις*, they sacrificed to Jupiter and Minerva. The third day, which they called *κυρεωτις*, such of their young men and maids as were of age were admitted into their tribes. The fourth day they called *επιβδης*.

APAULIA, in antiquity, the third day of a marriage solemnity. It was thus called, because the bride, returning to her father's house, did *απαυλιζεσθαι τυ νυμφιω*, lodge apart from the bridegroom. Some will have the apaulia to have been the second day of the marriage, viz. that whereon the chief ceremony was performed; thus called by way of contradistinction from the first day, which was called *προαυλια*. On the day called *απαυλια* (whenever that was), the bride presented her bridegroom with a garment called *απαυλητηρια*.

APE, in zoology, the general English name of a very numerous race of animals, the natural history of which is given at large under the article SIMIA: comprehending *Apes* properly so called, or such as want tails; and *Monkeys* and *Baboons*, or such as have tails, the former *long*, and the other *short*, ones. See SIMIA.

Sea-APE, a name given by Steller to a marine animal which he saw on the coast of America, and is thus described*. "The head appeared like that of a dog, with sharp and upright ears, large eyes, and with both lips bearded: the body round and conoid; the thickest part near the head: the tail forked; the upper lobe the longest: the body covered with thick hair, grey on the back, reddish on the belly. It seemed destitute of feet. It was extremely wanton, and played a multitude of monkey-tricks. It sometimes swam on one side, sometimes on the other side of the ship, and gazed at it with great admiration. It made so near an approach to the vessel, as almost to be touched with a pole; but if any body moved, it instantly retired. It would often stand erect for a considerable space, with one-third of its body above water; then dart beneath the ship, and appear on the other side; and repeat the same thirty times together. It would frequently arise with a sea-plant, not unlike the bottle-gourd, toss it up, and catch it in its mouth, playing with it numberless fantastic tricks.

* *Hist. of Kamtschatka*, p. 136.

APELYTES, Christian heretics in the second century, who affirmed that Christ received a body from the four elements, which at his death he rendered back to the world, and so ascended into heaven without a body.

APELLA, among physicians, a name given to those whose prepuce is either wanting or shrunk, so that it can no longer cover the glans. Many authors have supposed this sense of the word *Apella* warranted from the passage in Horace, *credat Judæus Apella, non ego*. But, according to Salmasius and others, *Apella* is the proper name of a certain Jew, and not an adjective signifying *circumcised*.

APELLIS, one of the most celebrated painters of antiquity. He was born in the isle of Cos, and flourished in the time of Alexander the Great, with whom he was in high favour. He executed a picture of this prince, holding a thunderbolt in his hand: a piece, finished with so much skill and dexterity, that it used to be said there were two Alexanders; one invincible, the son of Philip; the other inimitable, the production of Apelles. Alexander gave him a remarkable proof of his regard: for when he employed Apelles to draw Campaspe, one of his mistresses, having found that he had conceived an affection for her, he resigned her to him; and it was from her that Apelles is said to have drawn his Venus Anadyomene.

One of Apelles's chief excellencies was his making his pictures so exactly resemble the persons represented; insomuch that the physiognomists are said to have been able to form a judgment of the persons destiny as readily from his portraits as if they had seen the originals. But what is called *grace* was the characteristic of this artist. His pencil was so famous for drawing fine lines, that Protogenes discovered by a single line that Apelles had been at his house. Protogenes lived at Rhodes: Apelles sailed thither, and went to his house with great eagerness, to see the works of an artist who was known to him only by name. Protogenes was gone from home: but an old woman was left watching a large piece of canvas, which was fitted in a frame for painting. She told Apelles that Protogenes was gone out; and asked him his name, that she might inform her master who had inquired for him. "Tell him (says Apelles) he was enquired for by this person;"—at the same time taking up a pencil, he drew on the canvass a line of great delicacy. When Protogenes returned, the old woman acquainted him with what had happened. That artist, upon contemplating the fine stroke of the line, immediately pronounced that Apelles had been there; for so finished a work could be produced by no other person. Protogenes, however, himself drew a finer line of another colour; and, as he was going away, ordered the old woman to show that line to Apelles if he came again; and to say, "This is the person for whom you are enquiring." Apelles returned, and saw the line: he would not for shame be overcome; and therefore, in a colour different from either of the former, he drew some lines so exquisitely delicate, that it was utterly impossible for finer strokes to be made. Protogenes now confessed the superiority of Apelles, flew to the harbour in search of him, and resolved to leave the canvass with the lines on it for the astonishment of future artists.

Apelles showed great liberality of mind towards Protogenes. With ideas enlarged by education and literature, he was incapable of harbouring little jealousies of noble competitors; on the contrary, he was the first who made the works of Protogenes to be valued as they deserved among the Rhodians. He acknowledged that Protogenes was in some respects superior to himself; but that in one particular himself excelled, viz. in knowing when to take his hand from the Picture; an art which Protogenes had not yet learned, and therefore over-worked his pieces. Apelles equally disapproved of too elaborate diligence, or too hasty negligence, in execution. A studied work of Protogenes he esteemed less on the one account; and on the other, when a silly painter once brought him a picture, and said, "This I painted in a hurry,"—he replied, "Though you had not told me so, I perceive it was painted in haste: but I wonder you could not execute more such pieces in the same time.

There are two stories related of Apelles, which show him to be at once an artist of modesty in amending even trifling improprieties, when pointed out to him by competent judges; and yet of self-confidence sufficient to make him know the perfection and value of his own paintings. It was customary with Apelles to expose to public view the works which he had finished, and to hide himself behind the picture, in order to hear the remarks passed on it by persons who chanced to view it. He once overheard himself blamed by a shoemaker for a fault in the slippers of some picture: he corrected the fault which the man had noticed: but on the day following the shoemaker began to animadvert on the leg; upon which Apelles with some anger looked out from behind the canvass, and bade him keep to his own province, "Ne sutor ultra crepidam." It is well known that Alexander forbade any one besides Apelles to paint his portrait. We are not, however, to conclude from this, that Alexander was a more skilful judge of painting than he was of poetry. Like Augustus, he cherished the fine arts more from vanity than taste. A remarkable proof is given of this prince's inability to discern merit, and of the painter's freedom in expressing the mortification he felt, when a work of his was not sufficiently commended. "Alexander (says Ælian, lib. ii. c. 3. Var. Hist.) having viewed the picture of himself which was at Ephesus, did not praise it as it deserved. But when a horse was brought in, and neighed at seeing the figure of a horse in the picture, as though it had been a real horse; *O king!* (said Apelles) *this horse seems to be by far a better judge of painting than you.*" It happened more than once that the horses drawn by him were mistaken for real ones, by living horses which saw and neighed at the pictures. In his finishing a drawing of this animal, a remarkable circumstance is related of him. He had painted a horse returning from battle, and had succeeded to his wishes in describing every other mark that could indicate a mettlesome steed, impatient of restraint; there was wanting nothing but a foam of a bloody hue issuing from the mouth. He again and again endeavoured to express this, but his attempts were unsuccessful. At last, with vexation, he threw against the reins of the horse a sponge which had in it many colours; a mixture of which coming out of the sponge, and tinging the reins, produced the very effect desired by the painter.

The works of Apelles were all admired; but the most celebrated were the picture of Alexander in the temple of Diana at Ephesus, and that of Venus emerging from the sea. Alexander was drawn with thunder in his hand; and such relief was produced by the chiaroscuro in this piece, that the fingers seemed to shoot forward, and the thunder-bolt to be out of the picture. His Venus Αναδυομενη was esteemed the most exquisite figure which the pencil could create: it is therefore extolled by the Roman poets Propertius and Ovid; and the poet of Sidon, Antipater, has left us the following Greek epigram on it:

Ταν αναδυομεναν απο ματερος αρτι θαλαττας
  Κυπριν, Απελλειυ μοχθον ορα γραφιδος,
Ως χερι συμμαρψασα διαβροχον υδατι καιταν
  Εκθλιβει νοτερων αφρον απο πλοκαμων.
Αυται νυν ερευσιν Αθηναιη τε και Ηρη
  "Ουκ ετι σοι μορφας εις εριν ερχομεθα."

Anth. iv. 12.

Graceful as from her natal sea she springs,
  Venus, the labour of Apelles, view:
With pressing hand her humid locks she wrings,
  While from her tresses drips the frothy dew:
Ev'n Juno and Minerva now declare,
  "No longer we contend whose form's most fair."

APENE, in antiquity, a kind of chariot wherein the images of the gods were carried in procession on certain days, attended with a solemn pomp, songs, hymns, dancing, &c. It was very rich, made sometimes of ivory, or of silver itself, and variously decorated.

APPENNINUS, now the *Appennine*; a mountain, or ridge of mountains, running through the middle of Italy, from north-west to the south-west for 700 miles, in the form of a crescent, (Pliny); beginning at the Alps in Liguria, or the Rivierra di Genoa; and terminating at the strait of Messana, or at Reggio, and the promontory Leucopetra; and separating, as by a back or ridge, the Adriatic from the Tuscan sea, (Pliny, Strabo, Ptolemy, Polybius, Vitruvius). This mountain, though high, is greatly short of the height of the Alps. Its name is Celtic, signifying a *high mountain*.

APENRADE, a town of Denmark, in the duchy of Sleswick, seated at the bottom of a gulph in the Baltic sea, between Flensbourg and Hadaschleben. It is 25 miles north from Sleswick. E. Long. 9. 28, N. Lat. 55. 4.

APENZEL, a town of Switzerland, in the canton of the same name, seated on the river Chuz, E. Long. 9. 1. N. Lat. 47. 31. The canton itself, which was allied to the others in 1513, consists only of three or four valleys; having the town and abbey of St Gall on the north; the county of Toggenburg on the west; the lordship of Sax in the canton of Zurich, and that of Gambs in the canton of Shweiz, on the south; and the Rheinthall, or Rhine-valley, on the east. Its greatest length is about 30 miles, and its breadth about 20. It yields good pasturage, and consequently is not destitute of cattle, milk, butter, or cheese. Considerable quantities also of wheat, rye, barley, oats beans, pease, flax, and wine, are produced in it; besides a great deal of fruit, wood, and turf; with mineral waters, and warm baths. There are many mountains in the canton, the highest of which it that called the *Hohesantis*, or the *Hohe-Mesmer*, which commands a prospect of a prodigious extent. There are also several lakes and rivers. The inhabitants, who are partly Protestants,

testants, and partly Roman-catholis, subsist chiefly by their manufactures of linen, crape, fustian, and thread, or by bleaching, and the sale of their cattle, butter, cheese, horses, wood, and coal. Of the twenty-three parishes in the canton, four are Popish, and nineteen protestant. Before the Reformation, the inhabitants were subject to the abbot of St. Gall; but they then shook off his yoke, and united themselves with the other cantons: after that, however, there were violent animosities between the Papists and Protestants, the former continually persecuting the latter, till at last, in 1587, by the mediation of the other cantons, the two parties came to an accommodation, by which certain districts were assigned to each party, whereas before they lived promiscuously together; and though these two divisions now constitute but one canton, yet each forms a distinct community or free state, sending its particular representatives to the diets of the confederacy, and having its separate councils and officers. In spirituals the Papists are subject to the bishop of Constance, but the Protestants to their own consistory. The militia of the former does not exceed 3000, whereas those of the latter amount to 10,000.

APEPSIA, (from α neg. and πεπτω, to *digest*.) Indigestion.

Abstemiousness and excess are alike causes of indigestion. An over-distension of the stomach may in some measure injure its proper tone; and long fasting, by inducing a bad quality in the juices secerned into the stomach, renders it feeble, and generates wind. Hard drinking, and any of the causes of an anorexy, also injure digestion.

The columbo root is said to be particularly useful when the stomach is languid, the appetite defective, digestion with difficulty carried on, or when a nausea with flatulency attends. It is prescribed in substance with any grateful aromatic, or infused in Madeira wine, now and then interposing gentle doses of the tincture of rhubarb.

A mixture of mustard-seed with the columbo root is of admirable utility in complaints of this kind; particularly where acidity and flatulence prevail much in the primæ viæ.

APER, in zoology, a synonime of the sus scrofa. See Sus.

APERIENTS, in the materia medica, an appellation given to such medicines as facilitate the circulation of the humours by removing obstructions.—The five aperient roots of the shops are smallage, fennel, asparagus, parsley, and butcher's broom.

APERTURE, the opening of any thing, or a hole or cleft in any continuous subject.

Aperture, in geometry, the space between two right lines which meet in a point and form an angle.

Aperture, in optics, a round hole in a turned bit of wood or plate of tin, placed within the side of a telescope or microscope, near to the object-glass, by means of which more rays are admitted, and a more distinct appearance of the object is obtained.

Apertures, or *Apertions*, in architecture, are used to signify doors, windows, chimnies, &c.

APETALOSE, or Apetalous, among botanists, an appellation given to such plants as have no flower-leaves.

APEX, the vertex or summit of any thing.

Apex, in antiquity, the crest of a helmet, but more especially a kind of cap worn by the flamens.

Apex, among grammarians, denotes the mark of a long syllable, falsely called a *long accent*.

APHACA, (anc. geog.) the name of a place in Syria, situated between Heliopolis and Byblus, near Lebanon; infamous for a temple of Venus, called *Aphacitis*, near which was a lake, round which fire usually burst forth, and its waters were so heavy, that bodies floated on them. The temple was destroyed by Constantine, as being a school of incontinence, (Eusebius). The name is of Syriac origin, signifying *embraces*.

APHÆRESIS, in grammar, a figure by which a letter or syllable is cut off from the beginning of a word. Thus *ciconio*, by aphæresis, is written *conia; contemnere, temnere; omittere, mittere*, &c.

A like retrenchment at the end of a word is called Apocope.

Aphæresis, in medicine, denotes a necessary taking away or removal of something that is noxious.—In surgery, it signifies an operation whereby something superfluous is taken away.

APHANES: a genus of the monogynia order, belonging to the tetrandia class of plants; and in the natural method ranking under the 35th order, *Senticosæ*. The essential characters are these: The calyx is divided into eight parts; there is no corolla; the seeds are two, and naked. There is only one species, the arvensis or pensley-piert, a native of Britain. It is extremely common in corn-fields. The stalks rise five or six together; they are three inches long, round, hairy, and procumbent: the leaves stand very thick upon them, and are roundish, but divided, as it were, into three parts, and those deeply serrated at their edges. The flower comes out in a double series, arranged all along the branches, and are of a greenish white, and the whole plant is of a greyish or whitish-green colour.

APHASIA, (from α, and φημι. "I speak,") in the sceptic philosophy, denotes a state of doubt, wherein a person not knowing what to determine on, it is best for him to be silent. In this sense, *Aphasia* stands opposed to *phasis*, under which are included both assertion and negation.

APHEK, the name of several cities mentioned in scripture. 1. Aphek in the tribe of Judah, where the Philistines encamped, when the ark was brought from Shiloh, which was taken by them in battle, 1 Sam. iv. 1, 2. &c. It is thought to be the same with Aphekah mentioned in Josh. xv. 53. 2. Aphek in the valley of Jezreel, where the Philistines encamped while Saul and his army were near Jezreel, upon the mountains of Gilboa, 1 Sam. xxix. 1, &c. 3. APHEK a city belonging to the tribe of Asher, near the country of the Sidonians; (Josh. xix. 30, and xiii. 4.) 4. Aphek a city of Syria, one of the principal in Benhadad's kingdom, near which the battle was fought between Ahab and Benhadad, wherein the Syrians were worsted; and whereof, as they retreated with precipitation into the city, the walls fell upon them, and crushed in pieces 27,000, (1 Kings xx. 26, *et seq.*) This city lay between Heliopolis and Biblos.

APHELIUM, or Aphelion, in astronomy, is that point in any planet's orbit, in which it is farthest diſtant from the ſun, being that end of the greater axis of the elliptical orbit of the planet moſt remote from the focus where the ſun is.

APHIOM KARAHISSART, a town of Natolia, in Aſiatic Turkey; it is named *Aphiom*, becauſe it produces a great deal of opium, called *aphiom* by the Turks. E. Long. 32. 18. N. Lat. 38. 35.

APHIS, in zoology, the PUCERON, VINE-FRETTER, or PLANT-LOUSE; a genus of inſects belonging to the order of inſecta hemiptera. The roſtrum or beak of the aphis is inflected; the antennæ or feelers are longer than the thorax; the wings are four, and erect, or they are wanting; the feet are of the ambulatory kind; and the belly often ends in two horns, from which is ejected that moſt delicate juice called *Honey-dew*. HONEY-DEW.

Linnæus enumerates 33 ſpecies of the aphis, all of them inhabitants of particular plants, from which their trivial names are taken; as, aphis *ribis*, *ulmi*, *roſæ*, &c.: And he adds, that there ſeem to be a greater variety of plants producing aphides than there are different ſorts of this inſect. But ſome late obſervers have been able to diſtinguiſh more than double the above number of ſpecies; and it is probable that many more remain ſtill to be added, as many of the ſame kind of plants are found to ſupport two or three quite different ſorts of aphides. Thus the plum-tree has two ſorts very diſtinct from each other: one of a yellowiſh green, with a round ſhort body; the other of a bluiſh green, as it were enamelled with white, and the ſhape more oblong. On the gooſe-berry buſh and currant the ſame aphides may be found; but each of theſe is inhabited by two very different ſpecies: one being of a duſky green, with a ſhort plump body; the other of a paler green, the body more taper, and tranſverſely wrinkled. The roſe-tree, again, ſupports not leſs than three diſtinct ſpecies: the largeſt is of a deep green, having long legs of a browniſh caſt, with the joints of a very dark brown, as are alſo the horns and antennæ; a ſecond ſort is of a paler green, has much ſhorter legs, and a more flat body; the third ſort is of a pale red, its body traſverſely wrinkled, and is moſt frequently on the ſweet-briar.

The extraordinary nature of theſe inſects have for ſome time paſt juſtly excited the wonder and attention of naturaliſts. They were long ranked among the animals which had been claſſed with the true androgynes ſpoken of by Mr Breynius: for having never been catched copulating, it was haſtily concluded that they multiplied without copulation. This, however, was but a doubt, or at beſt a mere ſurmiſe: but this ſurmiſe was believed and adopted by Mr Reaumur; and though he ſupported it by ſome obſervations peculiar to himſelf, the queſtion remained ſtill undecided, till Mr Bonnet ſeemed to have cleared it up in the affirmative, by taking and ſhutting up a young aphis at the inſtant of its birth, in the moſt perfect ſolitude, which yet brought forth in his ſight 95 young ones. The ſame experiment being made on one of the individuals of this family, that had been tried with its chief, the new hermit ſoon multiplied like its parent; and one of this third generation, in like manner brought up in ſolitude, proved no leſs fruitful than the former. Repeated experiments, in this reſpect, as far as the fifth or ſixth generation, all uniformly preſenting the obſerver with *fecund virgins*, were communicated to the Royal Academy of Sciences; when an unforeſeen and very ſtrange ſuſpicion, imparted by Mr Trembley to Mr Bonnet, engaged him anew in a ſeries of ſtill more painful experiments than the foregoing. In a letter which that celebrated obſerver wrote to him from the Hague, the 27th January, 1741, he thus expreſſes himſelf: "I formed ſince the month of November, the deſign of rearing ſeveral generations of ſolitary pucerons, in order to ſee if they would all equally bring forth young. In caſes ſo remote from uſual circumſtances, it is allowed to try all ſorts of means; and I argued with myſelf, Who knows, that but one copulation might ſerve for ſeveral generations? This "*who knows*," to be ſure, was next to avouching nothing; but as it came from Mr. Trembley, it was ſufficient to perſuade Mr Bonnet that he had not gone far enough in his inveſtigation. If the fecundity of aphides was owing to the ſecret copulation ſuggeſted by Mr Trembley; this copulation ſerved at leaſt five or more ſucceſſive generations. Mr Bonnet therefore reared to the amount of the tenth generation of ſolitary aphides, and had the patience to keep an account of the days and hours of the birth of each generation. In ſhort, it was diſcovered, That they are really diſtinguiſhed by ſexes: That there are males and females among them, whoſe amours are the leaſt equivocal of any in the world: that the males are produced only in the tenth generation, and are but few in number: that theſe, ſoon arriving at their full growth, copulate with the females: that the virtue of this copulation ſerves for ten generations: that all theſe generations, except the firſt (from the fecundated eggs), are produced viviparous; and all the individuals are females, except thoſe of the laſt generations, among whom, as we have already obſerved, ſome males make their appearance, to lay the foundations of a freſh ſeries.—Theſe circumſtances have been confirmed by other naturaliſts. In particular, we have a curious and accurate detail of them by Dr Richardſon of Rippon, in the Philoſophical Tranſactions, Vol. xi. art. 22. an extract of which we ſhall here inſert, in order to give the reader as full an inſight into the nature of theſe ſingular inſects, as can be done by a mere detail of facts in themſelves utterly unaccountable.

"The great variety of ſpecies which occur in the inſects now under conſideration, may make an inquiry into their particular nature ſeem not a little perplexed; having them, however, ſkilfully reduced under their proper genus, the difficulty is by this means conſiderably diminiſhed. All the inſects comprehended under any diſtinct genus, we may reaſonably ſuppoſe to partake of one general nature; and, by diligently examining any of the particular ſpecies, may thence gain ſome inſight into the nature of all the reſt. With this view I have choſen, out of the various ſorts of aphides, the largeſt of thoſe found on the roſe-tree; not only as its ſize makes it the more conſpicuous, but as there are few others of ſo long a duration. This ſort, appearing early in the ſpring, continues late in the autumn; while ſeveral are limited to a much ſhorter term, in conformity to the different trees and plants from whence they drew their nouriſhment.

1. "If at the beginning of February the weather happens to be ſo warm as to make the buds of the roſe-tree ſwell and appear green; ſmall aphides are frequently to be found upon them, not larger than the young

Aphis. young ones in summer when first produced. But there being no old ones to be found at this time of the year, which in summer I had observed to be viviparous, I was formerly not a little perplexed by such appearances, and almost induced to give credit to the old doctrine of equivocal generation. That the same kind of animal should at one time of the year be viviparous, and at another time oviparous, was an opinion I could then by no means entertain. This, however, frequent observation has at last convinced me to be fact; having found those aphides which appear early in the spring, to proceed from small black oval eggs which were deposited on the last year's shoots in autumn: though, when it happens that the insects make too early an appearance, I have observed the greatest part to suffer from the sharp weather that usually succeeds, by which means the rose-trees are some years in a manner freed from them.

"Those which withstand the severity of the weather seldom come to their full growth before the month of April; at which time they usually begin to breed, after twice casting off their exuviæ or outward covering. It appears then that they are all females, which produce each of them a very numerous progeny, and that without having intercourse with any male insect. As I observed before, they are viviparous; and what is equally uncommon, the young ones all come into the world backwards. When they first come from the parent, they are enveloped by a thin membrane, having in this situation the appearance of an oval egg; which, I apprehend, must have induced Reaumur to suspect that the eggs discovered by Bonnet were nothing more than mere abortions. These egg-like appearances adhere by one extremity to the mother; while the young ones contained in them extend the other; by that means gradually drawing the ruptured membrane over the head and body to the hind feet. During this operation, and for some time after, by means of something glutinous, the fore part of the head adheres to the vent of the parent. Being thus suspended in the air, it soon frees itself from the membrane in which it was confined, and, after its limbs are a little strengthened, is set down on some tender shoot, and then left to provide for itself.

2. "In the spring months, there appear on the rose-trees but two generations of aphides, including those which immediately proceed from the last year's eggs; the warmth of the summer adds so much to their fertility, that no less than five generations succeed one another in the interval. One is produced in May, which casts off its covering; while the months of June and July each supply two more, which cast off their coverings three or four times, according to the different warmth of the season. This frequent change of the outward covering is the more extraordinary, as it is the oftenest repeated when the insects come the soonest to their growth; which I have sometimes observed to happen in ten days, where warmth and plenty of nourishment have mutually conspired. From which considerations I am thoroughly convinced that these various coverings are not connate with the insect; but that they are, like the scarf-skin, successively produced.

"Early in the month of June, some of the third generation which were produced about the middle of May, after casting off their last covering, discover four erect wings, much longer than their bodies: and the same is observable in all the succeeding generations, which are produced during the summer months; without, however, distinguishing any diversity of sex, as is usual in several other kinds of insects. For some time before the aphides come to their full growth, it is easy to discover which of them will have wings, by a remarkable fullness of the breast, which, in the others, is hardly to be distinguished from the body. When the last covering is rejected, the wings, which were before folded up in a very narrow compass, gradually extend themselves in a most surprising manner, till their dimensions were at last very considerable. But these winged ones have the peculiarity, that the number of them does not seem so much to depend on their original structure, as on the quantity or quality of the nourishment with which they are supplied: it being frequently observed, that those on a succulent shoot have few or none with wings among them, while others of the same generation, on a less tender branch, are most of them winged; as if only the first rudiments of wings were composed in the former, while nature thought proper to expand them in the latter, that they might be more at liberty to supply their wants.

"The increase of these insects in the summer-time is so very great, that, by wounding and exhausting the tender shoots, they would frequently suppress all vegetation, had they not many enemies which restrain them. To enumerate the variety of other insects that in their worm and fly state are constantly destroying them, would exceed the bounds of the present design: there is one, however, so singular in the manner of executing its purpose, that I cannot pass by it without some further notice. This is a very small black ichneumon fly, with a slender body and very long antennæ, which darts its pointed tail into the bodies of the aphides, at the same time depositing an egg in each. This egg produces a worm, which feeds upon the containing insect till it attains its full growth; when it is usually changed to that kind of fly from whence it came. In this, however, it is sometimes prevented by another sort of small black fly, which wounds this worm through its pear-like habitation; and by laying one of its eggs therein, instead of the former fly, produces its own likeness. I must, however, further observe, notwithstanding these insects have many enemies, they are not without friends; if we may consider those as such who were very officious in their attendance, for the good things they expect to reap thereby. The ant and the bee are both of this kind, collecting the honey in which the aphides abound; but with this difference, that the ants are constant visitors, the bee only when flowers are scarce. To which let me also add, that the ants will suck in the delicious nectar while the aphides are in the act of discharging it from the anus; but the bees only collect it from the leaves on which this honey-dew has fallen.

3. "In the autumn I find three more generations of aphides to be produced; two of which make their appearance in the month of August, and the third usually appear before the middle of September. As the two first differ in no respect from those which we meet with in summer, it would be wasting time to dwell any longer upon them; but the third, differing greatly from all the rest, demands our giving it a more

Aphis.

serious attention. Though all the aphides which have hitherto appeared were females, in this tenth generation are found several male insects; not that they are by any means so numerous as the females, being only produced by a small number of the former generation. To which I must further add, that I have observed those which produce males, previously to have produced a number of females; which in all respects resembling those already described, I shall decline taking into any further consideration.

"The females have at first altogether the same appearance with those of the former generations; but, in a few days their colour changes from a green to a yellow, which is gradually converted into an orange colour before they come to their full growth. They differ likewise in another respect, at least from those which occur in the summer, that all those yellow females are without wings. The male insects are, however, still more remarkable, their outward appearance readily distinguishing them from the females of this and of all other generations. When first produced, they are not of a green colour like the rest, but of a reddish brown; and have afterwards, when they begin to thicken about the breast, a dark line along the middle of the back. These male insects come to their full growth in about three weeks time, and then cast off their last covering; the whole insect being, after this operation, of a bright yellow colour, the wings only excepted. But after this they soon change to a darker yellow, and in a few hours to a very dark brown; if we except the body, which is something lighter coloured, and has a reddish cast. They are all of the winged sort; and the wings, which are white at first, soon become transparent, and at length appear like very fine black guaze.

"The males no sooner come to maturity than they copulate with the females; in which act they are readily discovered, as they remain in conjunction for a considerable time, and are not easily disturbed. The commerce between them continues the whole month of October, and may be observed at all times of the day, though I have found it most frequent about noon; especially when the weather is moderately warm, and the sun overcast. The females, in a day or two after their intercourse with the males, I have observed to lay their eggs; which they usually do near the buds, when they are left to their own choice. Where there are a number crowded together, they of course interfere with each other; in which case they will frequently deposite their eggs on other parts of the branches, or even on the spines with which they are beset."

These insects are found in great numbers not only on the stems and leaves, but even upon roots of many trees and plants. Those trees that are most loaded with the insects, as already observed, suffer greatly from them. The plant-lice thrust their sharp-pointed rostrum into the substance of the leaf to draw out their sustenance, which warps the stem and leaves, and occasions in the latter cavities underneath, and swellings above; nay, even in some, a kind of hollow gall filled with insects, as is often seen on elm-leaves.

See plate I. (vol. i.)

It appears astonishing that the slight puncture of so small an animal should so greatly disfigure a plant: but it must be remembered, that plant-lice always live in numerous associations, which increase visibly by the prodigious fruitfulness of those insects; so that although each puncture be slight, yet the number of them is so great, so reiterated, that it is no longer a wonder the leaves should be disfigured. Lovers of gardening and plants are extremely anxious to free and cleanse their trees from this vermin; but their care often proves unavailing, the insect is so fruitful that it soon produces a fresh colony. The best and surest method of extirpating it, is to put on the trees infested with them some larvæ of the plant-louse lion, or aphidivorous flies*; for those voracious larvæ destroy every day a great number of the insects, and that with so much the more facility, as the latter remain quiet and motionless in the neighbourhood of these dangerous enemies, who range over heaps of plant-lice, which they gradually waste and diminish.

* See *Coccinella*, *Ichnemon*, *Hemerobius*, &c.

Aphlastum ‖ Aphrodita.

APHLASTUM, in the ancient navigation, a wooden ornament, shaped like a plume of feathers, fastened on the goose's or swan's neck used by the ancient Greeks in the heads of their ships. The aphlastum had much the same office and effect in a ship than the crest had on the helmet. It seems also to have had this further use, viz. by the waving of a party-coloured ribband fastened to it, to indicate from what quarter the wind blew.

APHONIA, among physicians, signifies a suppression or total loss of voice. It is never a primary disease; but a consequence of many different disorders. The cure is to be effected by removing the disorder from whence the aphonia proceeds.

APHORISM, a maxim or principle of a science; or a sentence which comprehends a great deal in a few words. The word comes from αφοριζω, *I separate*; q. d. a choice or select sentence.—The term is chiefly used in medicine and law. We say, the aphorisms of Hippocrates, of Sanctorius, of Boerhaave, &c. aphorisms of the civil law, &c.

APHRACTI, in the ancient military art, denotes open vessels, without decks or hatches, furnished only at head and stern, with cross planks, whereon the men stood to fight.

APHRODISIA, in antiquity, festivals kept in honour of Venus, the most remarkable of which was that celebrated by the Cyprians. At this solemnity several mysterious rites were practised: all who were initated to them offered a piece of money to Venus as an harlot, and received as a token of the goddess's favour a measure of salt, and a φαλλος; the former, because salt is a concretion of sea-water, to which Venus was thought to owe her birth; the latter, because she was the goddess of wantonness.

APHRODISIACS, among physicians, medicines which increase the quantity of semen, and create an inclination to venery.

APHRODITA, in zoology, an insect of the order of vermes mollusca. The body of the aphrodita is oval, with many small tentacula or protuberances on each side, which serve as so many feet: The mouth is cylindrical at one end of the body, and capable of being retracted, with two bristly tentacula. There are four species of this insect; viz. 1. The aculeata, by some called the *sea-mouse*, with 32 tentacula or feet, an inhabitant of the European seas, and often found in the belly of the cod-fish. It feeds upon shell-fish. See Plate XVII. fig. 4. 2. The scabra, of an oblong shape, scabrous

scabrous on the back, with 20 tentacula. It inhabits the Belgic sea. It is sometimes taken off Brighthelmstone, an inch long. 3. The squamata, with 24 feet, and scaly on the back. The mouth is wrapt up in an aperture, and the tail is terminated by a few very short bristles. It inhabits the European ocean. 4. The imbricata, is very like the former, only its scales are more glabrous. It inhabits the northern ocean.

APHRODITE, in mythology, a name of Venus, derived from αφρος, *froth*; because, according to the poets, Venus is supposed to have been produced from the froth or foam of the sea.

APHRONITRE, in natural history, a name given by the ancients to a particular kind of natrum.

APHTHÆ, in medicine, small, round, and superficial ulcers arising in the mouth. See MEDICINE-*Index*.

APHTHARTODOCETÆ, a sect sworn enemies of the council of Chalcedon. The word is derived from αφθαρτος, *incorruptible*, and δοκεω, *I imagine*; and was given them, because they imagined the body of Jesus Christ was incorruptible and impassible, and not capable of death. They arose among the Eutychians, and made their first appearance in the year 535.

APHYLLANTHES, LEAFLESS FLOWER, or BLUE MONTPELLIER PINK: A genus of the monogynia order, belonging to the hexandria class of plants; and in the natural method ranking under the 5th order, *Tetrapetaloidæ*. In character it differs not from the JUNCUS or rush, but in having a calyx of six petals, whereas the juncus has no calyx. There is only one species, the Monspelienses, a native of France. The root consists of a number of slender, hard, woody, long and contorted fibres: the radical leaves are very numerous, two inches long, extremely narrow, and wither very quickly. The stalk is round, smooth, without a joint or knot, naked, and tolerably firm; at its top stands a single and very beautiful blue flower, arising from a kind of compound imbricated cup.

APIARY, a place where bees are kept. See the article BEE.

APIASTER, in ornithology, the trivial name of a species of the merops. See MEROPS.

APICES, in botany, the same with ANTHERÆ.

APICIUS. There were at Rome three of that name, famous for their gluttony: the second is the most celebrated of the three. He lived under Tiberius, spent immense sums on his belly, and invented divers sorts of cakes which bore his name. He kept as it were a school of gluttony at Rome. After having spent two millions and a half in entertainments, finding himself very much in debt, he examined into the state of his affairs; and seeing that he had but 250,000 livers remaining, he poisoned himself, out of apprehension of starving with such a sum. He had prostituted himself when very young to Sejanus.

APINA, or *Apinæ*, a town of Apulia, built by Diomedes, as was also Tricæ, (Pliny). *Apinæ* and *Tricæ* is a very proverbial saying for things trifling and of no value, (Martial); and *Apinarii* was the appellation for triflers or buffoons, (Trebellius Pollio.)

APION, a famous grammarian, born in Egypt, was a professor at Rome in the reign of Tiberius. He had all the arrogance of a mere pedant, and amused himself with difficult and insignificant inquiries. One of his principal works was his Antiquities of Egypt.

APIS, in mythology, a divinity worshipped by the ancient Egyptians at Memphis. It was an ox, having certain exterior marks; in which animal the soul of the great Osiris was supposed to subsist. This animal had the preference to all others, as being the symbol of agriculture, the improvement of which that prince had so much at heart.

According to several learned writers on the Egyptian religion, Apis was only a symbolical deity. "Amongst the animals consecrated to ancient rites (says Ammianus Marcellinus), Mnevis and Apis are the most celebrated: the first is an emblem of the sun, the second of the moon." Prophyry tells us, that Apis bore the characteristic signs of the two stars; and Macrobius, who confirms this opinion, adds, that he was equally consecrated to them both.

This bull, become the object of public adoration, it may be supposed, could not be born like other animals; accordingly the priests published that his origin was celestial. "An Apis is seldom born, says Pomponius Mela. He is not produced by the ordinary laws of generation. The Egyptians say he owes his birth to celestial fire." Plutarch explains this passage: "The priests pretend that the moon diffuses a generative influence, and as soon as a cow who takes the bull is struck by it, she conceive an Apis. Accordingly we discover in him the signs of that star."

Such were the fables industriously spread by those who presided over the divine institutions. The vulgar, to whom this emblematical deity presaged abundance, received them eagerly, and implicitly believed them. Pliny has described the characters which distinguished this sacred bull: "A white spot, resembling a crescent, on the right side, and a lump under the tongue, were the distinguishing marks of Apis." When a cow, therefore, which was thought to be struck with the rays of the moon, produced a calf, the sacred guides went to examine it, and if they found it conformable to this description, they announced to the people the birth of Apis, and fecundity.

"Immediately (says Ælian), they built a temple to the new god, facing the rising sun, according to the precepts of Mercury, where they nourished him with milk for four months. This term expired, the priests repaired in pomp to his habitation, and saluted him by the name of Apis. They then placed him in a vessel magnificently decorated, covered with rich tapestry, and resplendent with gold, and conducted him to Nilopolis, singing hymns, and burning perfumes. There they kept him for forty days. During this space of time, women alone had permission to see him, and saluted him in a particular manner. After the inauguration of the god in this city, he was conveyed to Memphis with the same retinue, followed by an innumerable quantity of boats, sumptuously decked out. There they completed the ceremonies of his inauguration, and he became sacred to all the world. Apis was superbly lodged, and the place where he lay was mystically called *the bed*. Strabo having visited his palace, thus describes it: "The edifice where Apis is kept, is situated near the temple of Vulcan. He is fed in a sacred apartment, before which is a large court. The house in which they keep the cow that produced him,

him, occupies one of its sides. Sometimes, to satisfy the curiosity of strangers, they make him go out into this court. One may see him at all times through a window; but the priests produce him also to public view." Once a year (says Solinus) they present a heifer to him, and the same day they kill her.

A bull, born in so marvellous a manner, must be possessed of supernatural knowledge. Accordingly the priests published, that he predicted future events by gestures, by motions, and other ways, which they construed according to their fancy. "Apis (says Pliny) has two temples called *Beds*, which serve as an augury for the people. When they come to consult him, if he enters into a particular one, it is a favourable presage, and fatal if he passes into the other. He gives answers to individuals by taking food from their hands. He refused that offered him by Germanicus, who died soon after." It would be unjust to conclude, that this respectable writer gave credit to such arguries. He relates the opinion of the Egyptians, and contents himself with citing facts without offering his judgment.

Such was the installation of Apis. His anniversary was always celebrated for seven days. The people assembled to offer sacrifices to him, and what is extraordinary oxen were immolated on the occasion. This solemnity did not pass without prodigies. Ammianus Marcellinus, who has collected the testimonies of the ancients, relates them in these words: "During the seven days in which the priests of Memphis celebrate the birth of Apis, the crocodiles forget their natural ferocity, become gentle, and do no harm to any body."

This bull, however, so honoured, must not exceed a mysterious term fixed for his life. "Apis (says Pliny) cannot live beyond a certain number of years. When he has attained that period, they drown him in the fountain of the priests; for it is not permitted, adds Ammianus Marcellinus, to let him prolong his life beyond the period prescribed for him by the sacred books." When this event happened, he was embalmed, and privately let down into the subterraneous places destined for that purpose. In this circumstance, the priests announced that Apis had disappeared; but when he died a natural death, before this period arrived, they proclaimed his death, and solemnly conveyed his body to the temple of Serapis.

"At Memphis was an ancient temple of Serapis, which strangers were forbidden to approach, and where the priests themselves only entered when Apis was interred. It was then (says Plutarch) that they opened the gates called *Lethes* and *Cocythe* (of oblivion and lamentation), which made a harsh and piercing sound."

Ammianus Marcellinus, and Solinus, paint with great energy the general despair of the Egyptians, who with cries and lamentations demanded another Apis from heaven.

According to Plutarch, the term prescribed for the life of Apis was 25 years; which number marked a period of the sun and of the moon, and the bull was consecrated to those two bodies. Syncellius, in his Chronography, when he comes down to the 32d Pharaoh, called *Aseth*, says, "Before Aseth, the solar year consisted of 360 days. This prince added five to complete its course. In his reign a calf was placed amongst the gods, and named *Apis*." And in the Bibliotheca of Fabricius we have the following passage: "It was customary to inaugurate the kings of Egypt at Memphis, in the temple of Apis. They were here first initiated in the mysteries, and were religiously invested; after which, they were permitted to bear the yoke of God, through a town to a place called the *Sanctuary*, the entrance of which was prohibited to the profane. There they will be obliged to swear that they would neither insert months nor days in the year, and that it should remain composed of 365 days, as had been established by the ancients."—From these facts Mr Savary, in his letters on Egypt, infers, that Apis was the tutelary divinity of the new form given to the solar year, and of the cycle of 25 years, discovered at the same time. This deity, besides, had a marked relation of the swelling of the Nile, as is testified by a great number of historians. The new moon which followed the summer solstice, was the æra of this phenomenon, on which the eyes of every body were fixed: And Pliny speaks as follows on this subject: "Apis had on his right side a white mark, representing the crescent: this mark (continues Ælian) indicated the commencement of the inundation." If Apis possessed the characteristic signs which proved his divine origin, he promised fertility and abundance of the fruits of the earth. It seems demonstrated therefore, Mr Savary adds, that this sacred bull, the guardian of the solar year of 365 days, was also regarded as the genius who presided over the overflowing of the river. The priests, by fixing the course of his life to 25 years, and by making the installation of a new Apis, concur with the renewal of the period above mentioned, had probably perceived, as the result of long meteorological observations, that this revolution always brought about abundant seasons, Nothing was better calculated to procure a favourable reception of this emblematical deity from the people, since his birth was a presage to them of a happy inundation, and of all the treasures of teeming nature.

The solemnity of his inauguration was called *Apparition*. That which was renewed every year towards the 12th or 13th of the month *Payn*, which corresponds with the 17th or 18th of June, was called *the birth of Apis*. It was a time of rejoicing, which Ælian describes in the following manner: "What festivals! what sacrifices take place in Egypt at the commencement of the inundation! It is then that all the people celebrate the birth of Apis. It would be tedious to describe the dances, the rejoicings, the shews, the banquets, to which the Egyptians abandon themselves on this occasion, and impossible to express the intoxication of joy which breaks forth in all the towns of the kingdom."

These observations Mr Savary thinks further confirmed by the name of this respectable bull; *Api*, in the Egyptian tongue, signifying number, measure. This epithet perfectly charactarizes an animal established as the guardian of the solar year, the type of the cycle of 25 years, and the presage of a favourable inundation.

Monsieur Huet, Bishop of Avranche, has endeavoured to prove that Apis was a symbolical image of the Patriarch Joseph, and has supported his opinion with

Apis. with all his erudition. Dr Bryant apprehends that the name of *Apis* was an Egyptian term for a father; that it referred to the Patriarch Noah; and that the crescent which was usually marked on the side of the animal, was a representation of the ark.

APIS, or BEE, in zoology, a genus of insects belonging to the order of insecta hymenoptera. The mouth is furnished with two jaws, and a proboscis infolded in a double sheath; the wings are four in number, the two foremost covering those behind when at rest: in the anus or tail of the females and working bees there is a hidden sting.

These insects are distinguished into several species, each of which has its peculiar genius, talents, manners, and disposition. Variety prevails in the order of their architecture, and in the nature of their materials. Some live in society, and share the toils; such are the common bee and the drone. Others dwell and work in solitude, building the cradles of their families; as the leaf-cutter bee does with the rose-tree leaf; the upholsterer with the gaudy tapestry of the corn-rose; the mason-bee with a plaster, the wood-piercer with sawdust. All are employed in their little hermitage, with the care of providing for the wants of their posterity. —The species enumerated by Linnæus are no fewer than 55; of which the following are the most remarkable:—

1. The florisomnis, or black bee with a cylindrical incurvated belly, having two tooth-like protuberances at the anus, and a kind of prickles on the hind-legs. This bee sleeps in flowers. 2. The dentata, or shining green bee, with black wings, and a kind of teeth on the hind thighs. The tongue of this bee is almost as long as its body. 3. The variegata: the breast and belly are variegated with white and black spots; the legs are of an iron colour. It is a native of Europe. This species sleeps in the geraneum phæum, or spotted crane's-bill. 4. The rostrata is distinguished by the upper lip being inflected and of a conical shape, and by the belly being invested with bluish belts. They build their nests in high sandy grounds, and there is but one young in each nest. 5. The ferruginea, or smooth black bee, with the feelers, mouth, belly, and feet, of an iron colour. This is a small bee, and supposed to be of an intermediate kind between the bee and wasp. It is a native of Europe. 6. The cariosa is a yellowish hairy bee; and the feet and front are of a bright yellow colour. It builds in the rotten trees of Europe. 7. The brasilianorum, or pale-red, hairy bee, with the basis of the thighs black. This is a very large bee, every where covered with a testaceous skin. It is a native of America. 8. The lapidaria, or red hairy bee, with a yellow anus, builds in holes of rocks. 9. The terrestris is black and hairy, with a white belt round the breast, and a white anus: it builds its nest very deep in the earth. 10. The violacea is a red bee, and very hairy, with bluish wings. It is a native of Europe. The violacea is said to perforate trees, and hollow them out in a longitudinal direction; they begin to build their cells at the bottom of these holes, and deposit an egg in each cell, which is composed of the farina of plants and honey or a kind of gluten. 11. The muscorum, or yellow hairy bee with a white belly, builds in mossy grounds. The skill displayed by these builders is admirable. In order to enjoy the pleasure of seeing their operations, let a nest be taken to pieces, and the moss conveyed to a distance. The bees will be seen to form themselves into a chain, from their nest to the place where the moss has been laid. The foremost lays hold of some with her teeth, clears it bit by bit with her feet (which circumstance has also gotten them the name of carding-bees), then, by the help of her feet, she drives the unravelled moss under her belly; the second, in like manner, pushes it on to the third. Thus there is formed an uninterrupted chain of moss, which is wrought and interwoven with the greatest dexterity by those that abide by the nest; and to the end, their nest may not be the sport of the winds, and may shelter them from rain, they throw an arch over it, which they compose with a kind of wax, tenaceous, though thin in substance, which is neither the unwrought bees-wax nor the real wax. Dissolved in oil of turpentine, it may be used in taking off impressions. 12. The centuncularis, leaf-cutter, or black bee, having its belly covered with yellow down. The nests of this species are made of leaves curiously plaited in the form of a matt or quilt. There are several varieties of the leaf-cutting bees, all equally industrious. They dig into the ground, and build their nests, of which some have the form and size of thimbles inserted one within another, others the shape and size of goose-quills. These nests are composed of pieces of leaves. Each sort of bees cut into its own materials; some the rose-leaf tree, others the horse chesnut. A careful observer may discover rose-tree leaves cut as it were with a pinking iron; and there he may procure himself the pleasure of seeing with what dexterity a bee, destitute of any mathematical instrument, cuts out a circular piece, fit to be either the bottom or the lid of one of those nests; others it cuts out into ovals and semi-ovals, which form the sides of the nest, into each of which it deposits one egg with ready prepared victuals. 13. The mellifica, or domestic honey-bee. But the particulars concerning this valuable species are so numerous and interesting as to require a separate article for their detail; which the reader will therefore find at due length under the English or popular name BEE.

In the Philosophical Transactions, N° 172*, we have an account of a species of honey-bee found in some parts of America, very different in form and manners from the common bee of Europe. Their combs are composed of a series of small bottles or bladders of wax, of a dusky brown or blackish colour: and each of these is much of the size and shape of a Spanish olive. They hang together in clusters, almost like a bunch of grapes, and are so contrived, that each of them has its aperture, while the bees are at work upon it; but as soon as it is filled with honey, this aperture is closed, and the bees leave it, and go to work upon another vessel. Their lodgings are usually taken up in the hollow of an old tree, or in some cavity of a rock by the sea-side. They are sagacious in choosing the most secure retreats, because their honey is so delicious a bait, that they are hunted after by many animals; and they have no power of defending themselves, having no stings as our bees have. The combs are brittle; and the honey is clear and liquid like rock-water. It is used by the natives rather as a drink with their food than as honey. They use it also in medicine as a purge, drinking half a pint of it in the morning fasting.

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The Abbé Clavigero, in his History of Mexico, mentions a species similar in every respect to ours, but without the sting. This is the bee of Yucatan and Chiapa, which makes the fine clear honey of *Estabentun*, of an aromatic flavour, superior to that of all the other kinds of honey with which we are acquainted. The honey is taken from them six times a-year, that is, once in every other month; but the best is that which is got in November, being made from a fragrant white flower like jessamine, which blows in September, called in that country *Estabentun*, from which the honey has derived its name. This honey is said to be in high estimation with the Europeans who touch at the ports of Yucatan. According to our author, the French of Guarico buy it sometimes for the purpose of sending it as a present to the king. Another species described by the same author, resembles in its form the winged ants, but is smaller than the common bee and without a sting. This insect, which is peculiar to warm and temperate climates, forms nests in size and shape resembling sugar-loaves, and even sometimes greatly exceeding these in size, which are suspended from rocks, or from trees, and particularly from the oak. The populousness of these hives are much greater than those of the common bee. The nymphs of this bee, which are eatable, are white and round, like a pearl. The honey is of a greyish colour, but of a fine flavour.

APIUM, PARSLEY: A genus of the digynia order, belonging to the pentandria class of plants; and in the natural menthod ranking under the 45th order, *Umbellatæ*. The fruit is of an oval shape, and streaked; the involucrum consists of one leaf; and the petals are inflected. There are only two species of apium; the petroselinum, or common parsley, a native of Sardinia; and the graveolens, or smallage, a native of Britain: the culture of both which are well known.

Medicinal Uses, &c. The roots and seeds of the *petroselinum* are used in medicine. The root of parsley is one of the five aperient roots, and in this intention is sometimes made an ingredient in apozems and diet-drinks: If liberally used, it is apt to occasion flatulencies; and thus, by distending the viscera, produces a contrary effect to that intended by it: the taste of this root is somewhat sweetish, with a light degree of warmth and aromatic flavour. The seeds are an ingredient in the electuary of bay-berries.—The roots of *smallage* are also in the number of aperient roots, and have been sometimes prescribed as an ingredient in aperient apozems and diet-drinks, but are at present disregarded. The seeds of the plant are moderately aromatic, and were formerly used as carminatives; in which intention they are, doubtless, capable of doing service, though the other warm seeds, which the shops are furnished with, render these unnecessary; and accordingly the Edinburgh college, which retains the roots, has expunged the seeds.

Besides its medicinal virtues above mentioned, the common parsley is reckoned an effectual cure for the rot in sheep, provided they are fed with it twice a-week for two or three hours each time: but hares and rabbits are so fond of this herb, that they will come from a great distance to feed upon it; and in the countries where these animals abound, they will destroy it if not very securely fenced against them; so that whoever has a mind to have plenty of hares in their fields, may draw them from all parts of the country by cultivating parsley.

APIVORUS, in ornithology, a synonime of a species of falco. See FALCO.

APLUDA: A genus of the monœcia order, belonging to the polygamia class of plants; and in the natural method ranking under the 4th order, *Gramina*. The calyx is a bivalved gluma; the floscules of the female are sessile, and the male floscules are furnished with pedunculi; the female has no calyx; the corolla has a double valve; there is but one stylus, and one covered seed. The male has three stamina. There are three species of apluda, viz. the mutica, aristata, and zengites, all natives of the Indies.

APOBATANA, the metropolis of Media, and where the kings kept their treasure (Isidorus Characenus); supposed to be the same wiih *Ecbatana*.

APOBATERION, in antiquity, a valedictory speech, or poem made by a person on departing out of his own country, and addressed to his friends or relations.

APOBATHRA, a place near Sestos (Strabo); the landing place where Xerxes ships were frozen and stuck in the ice (Eustathius).

APOCALYPSE, REVELATION, the name of one of the sacred books of the New Testament, containing revelations concerning several important doctrines of Christianity. The word is Greek, and derived from αποκαλυπτω, to *reveal*, or *discover*.

This book, according to Irenæus, was written about the year 96 of Christ, in the island of Patmos, whither St. John had been banished by the emperor Domitian. But Sir Isaac Newton places the writing of it earlier, viz. in the time of Nero. Some attribute this book to the arch-heretic Cerinthus: but the ancients unanimously ascribed it to John, the son of Zebedee, and brother to James; whom the Greek father call the *Divine*, by way of eminence, to distinguish him from the other Evangelists. This book has not, at all times, been esteemed canonical. There were many churches in Greece, as St Jerome informs us, which did not receive it; neither is it in the catalogue of canonical books prepared by the council of Laodicea, nor in that of St Cyril of Jerusalem; but Justin, Irenæus, Origin, Cyprian, Clemens of Alexandria, Tertullian, and all the fathers of the fourth, fifth, and the following centuries, quote the Revelations as a book then acknowledged to be canonical. The Alogians, Marcionites, Cerdonians, and Luther himself, rejected this book: but the Protestants have forsaken Luther in this particular; and Beza has strongly maintained against his objections, that the Apocalypse is authentic and canonical.

The Apocalypse consists of twenty-two chapters. The three first are an instruction to the bishops of the seven churches of Asia Minor. The fifteen following chapters contain the persecutions which the church was to suffer from the Jews, heretics, and Roman emperors. Next, St. John prophesies of the vengeance of God, which he will exercise against those persecutors, against the Roman empire, and the city of Rome; which, as the Protestants suppose, he describes under the name of Babylon, the great whore, seated upon seven

seven hills. In the last place, the 19th, 20th, 21st, and 22d chapters, describe the triumph of the church over its enemies, the marriage of the Lamb, and the happiness of the church triumphant.

"It is a part of this prophecy (says Sir Isaac Newton), that it should not be understood before the last age of the world; and therefore it makes for the credit of the prophecy, that it is not yet understood. The folly of interpreters has been to foretel times and things by this prophecy, as if God designed to make them prophets. By this rashness they have not only exposed themselves, but brought the prophecy also into contempt. The design of God was much otherwise: He gave this and the prophecies of the Old Testament, not to gratify mens curiosities, by enabling them to foreknow things: but that, after they were fulfilled, they might be interpreted by the events; and his own providence, not the interpreters, be then manifested thereby to the world. And there is already so much of the prophecy fulfilled, that as many as will take pains in this study, may see sufficient instances of God's providence."

There have been several other works published under the title of *Apocalypses*. Sozomen mentions a book used in the churches of Palestine, called the *Apocalypse*, or *Revelation of St Peter*. He also mentions an Apocalypse of St Paul; which the Cophtæ retain to this day. Eusebius also speaks of both these Apocalypses. St Epiphanius mentions an Apocalypse of Adam; Nicephorus, an Apocalypse of Esdras; Gratian and Cedrenus, an Apocalypse of Moses, another of St Thomas, and another of St Stephen; St Jerom, an Apocalypse of Elias. Porphyry, in his life of Plotin, makes mention of the Apocalypse or Revelations of Zoroaster, Zostrian, Nicothæus, Allogenes, &c.

APOCOPE, among grammarians, a figure which cuts off a letter or syllable from the end of the word; as *ingenî for ingenii*.

APOCRISARIUS, in ecclesiastical antiquity, a sort of resident in an imperial city, in the name of a foreign church or bishop, whose office was to negociate, as proctor, at the emperor's court, in all ecclesiastical causes in which his principals might be concerned. The institution of the office seems to have been in the time of Constantine, or not long after, when, the emperors being become Christians, foreign churches had more occasions to promote their suits at court than formerly. However, we find it established by law in the time of Justinian. In imitation of this officer, almost every monastery had its Apocrisarius, or resident, in the imperial city.

The title and quality of Apocrisary became at length appropriated to the Pope's agent, or *Nuncio*, as he is now called; who resided at Constantinople, to receive the Pope's dispatches, and the emperor's answers. The word is formed from Αποκρινειν, *to answer*.

APOCRUSTICS, in medicine, the same with repellents. See REPELLENTS.

APOCRYPHA, or APOCRYPHAL BOOKS, such books as are not admitted into the canon of scripture, being either not acknowledged as divine, or considered as spurious. The word is Greek; and derived from απο, and κρυπτω to *hide* or *conceal*.

When the Jews published their sacred books, they gave the appellations of *canonical* and *divine* only to such as they then made public: such as were still retained in their archives they called *apocryphal*, for no other reason but because they were not public; so that they might be really sacred and divine, though not promulged as such.

Thus, in respect of the Bible, all books were called *apocryphal* which were not inserted in the Jewish canon of scripture. Vossius observes, that, with regard to the sacred books, none are to be accounted apocryphal, except such as had neither been admitted into the synagogue nor the church, so as to be added to the canon, and read in public.

The protestants do not only reckon those books to be apocryphal which are esteemed such in the church of Rome, as the prayer of Manasseth king of Judah, the third and fourth books of Esdras, St Barnabas's epistle, the book of Hermos, the addition at the end of Job, and the 151st psalm; but also Tobit, Judith, Esther, the book of Wisdom, Jesus the son of Sirach, Baruch the prophet, the Song of the Three Children, the history of Susannah, the history of Bell and the Dragon, and the first and second books of Maccabees.

It is now pretended that these books were not received by the Jews, or so much as known to them. None of the writers of the New Testament cite or mention them: neither Philo nor Josephus speak of them. The Christian church was for some ages an utter stranger to these books. Origen, Athanasius, Hilary, Cyril of Jerusalem, and all the orthodox writers, who have given catalogues of the canonical books of scripture, unanimously concur in rejecting these out of the canon. And for the New Testament, they are divided in their opinions, whether the epistle to the Hebrews, the epistle of St James, and the second epistle of St Peter, the second and third epistles of John, the epistle of St Jude, and the Revelations, are to be acknowledged as canonical or not.

The Protestants acknowledge such books of scripture only to be canonical as were so esteemed to be in the first ages of the church; such as are cited by the earliest writers among the Christians as of divine authority, and after the most diligent enquiry were received and so judged to be by the council of Laodicea. The several epistles abovementioned, and the book of Revelations, whatever the sentiments of some particular persons are or may have been of them, are allowed by all the reformed churches to be parts of the canon of the New Testament.

The apocryphal books, however, according to the sixth article of the church of England, are to be read for example of life and instruction of manners; but it doth not apply them to establish any doctrine.

APOCYNUM, (Αποκυνον, of απο and κυων *a dog*, because the ancients believed this plant would kill dogs), DOGSBANE: A genus of the digynia order, belonging to the pentandria class of plants; and in the natural method ranking under the 30th order *Contortæ*. The essential characters are: The corolla is bell-shaped; and the filaments are five, alternate with the stamina.

Species. Of this genus botanical writers enumerate 11 species; of which the following are the most remarkable: 1. The venetum, with an upright herbaceous stalk, grows on a small island in the sea near Venice, but is supposed to have been originally brought from

from some other country. There are two varieties of this; one with a purple, and the other with a white flower. The roots creep very much, and by them only it is propagated; for it seldom produces any seeds either in the gardens where it is cultivated, or in those places where it grows naturally. Mr Miller tells us, that he had been assured by a very curious botanist, who resided many years at Venice, and constantly went to the spot several times in the season to procure the seeds, had any been produced, that he never could find any pods formed on the plants. The stalks rise about two feet high, and are garnished with smooth oval leaves placed opposite; the flowers grow at the top of the stalks, in small umbels, and make a very pretty appearance. The flowers appear in July and August. 2. The speciossimum, with large flowers, is a native of Jamaica in the savannahs, whence it has the name of *Savannah-flower*, by which it is generally known in that island. This sort rises three or four feet high, having woody stalks which send out a few lateral branches, garnished with smooth oval leaves placed by pairs opposite, of a shining green colour on their upper sides, but pale and veined underneath. The flowers are produced from the sides of the branches, upon long footstalks: there are commonly four or five buds at the end of each; but there is seldom more than one of them which comes to the flower. The flower is very large, having a long tube which spreads open wide at the top, of a bright yellow, and makes a fine appearance, especially in those places where the plants grow, naturally, being most part of the year in flower. 3. Cordatum with a climbing stalk. 4. The villosum, with hairy flowers and a climbing stalk. These were discovered at La Vera Cruz in New Spain, by Dr William Houston, who sent their seeds to England. They are both climbers and mount to the tops of the tallest trees. In England they have climbed over plants in the stoves, and risen to upwards of 20 feet high. The third sort has produced flowers several times: but the fourth never showed an appearance of any.

Culture. The first sort is hardy enough to live in England in the open air, provided it is planted in a warm situation and dry soil. It is propagated, as we have already observed, by its creeping roots; the best time for removing and planting which is in the spring, just before they begin to push out new stalks. The other sorts are propagated by seeds, but are so tender as to require being kept constantly in a stove.

Properties. All the species of this plant abound with a milky juice, which flows out from any part of their stalks and leaves when they are broken: this is generally supposed to be hurtful if taken inwardly, but doth not blister the skin when applied to it as the juice of spurge and other acrid plants. The pods of all the sorts are filled with seeds, which are for the most part compressed and lie over one another *imbricatim*, like the tiles of a house; these have each a long plume of a cottony down fastened to their crowns, by which, when the pods are ripe and open, the seeds are wafted by the wind to a considerable distance, so that the plants become very troublesome weeds. This down is in great esteem in France, for stuffing of easy chairs, making quilts, &c. for it is exceedingly light and elastic. It is called by the French *delawad*; and might probably become a vendible commodity in England, were people attentive to the collecting of it in Jamaica where the plants are found in plenty.

APODECTÆ, in antiquity, a denomination given to ten general receivers appointed by the Athenians to receive the public revenues, taxes, debts, and the like. The apodectæ had also a power to decide controversies arising in relation to money and taxes, all but those of the most difficult nature and highest concern, which were reserved to the courts of judicature.

APODECTÆI, in the Athenian government, officers appointed to see that the measures of corn were just.

APODES, in a general sense, denotes things without feet. Zoologists apply the name to a fabulous sort of birds, said to be found in some of the islands of the New World, which, being entirely without feet, support themselves on the branches of trees by their crooked bills.

APODES in the Linnæan system, the name of the *first order* of fishes, or those which have no belly-fins. See ZOOLOGY.

APODICTICAL, among philosophers, a term importing a demonstrative proof, or systematical method of teaching.

APODOSIS, in rhetoric, makes the third part of a complete exordium, being properly the application, or restriction of the *protasis*. The apodosis is the same with what is otherwise called *axiosis*; and stands opposed to *protasis*: e. gr. *protasis*, all branches of history are necessary for a student; *catesceue*, so that, without these, he can never make any considerable figure; *apodosis*, but literary history is of a more especial use, which recommends it, &c.

APODYTERIUM, in the ancient baths, the apartments where persons dressed and undressed.

APOGEE, in ASTRONOMY, that point in the orbit of a planet, which is at the greatest distance from the earth. The apogee of the sun is that part of the earth's orbit which is at the greatest distance from the sun; and consequently the sun's apogee, and the earth's aphelion, are one and the same point.

APOLIDES, in antiquity, those condemned for life to the public works, or exiled into some island, and thus divested of the privileges of Roman citizens.

APOLLINARIAN GAMES, in Roman antiquity, were instituted in the year of Rome 542. The occasion was a kind of oracle delivered by the prophet Marcus after the fatal battle at Cannæ, declaring, that to expel the enemy, and cure the people of an infectious disease which then prevailed, sacred games were to be annually performed in honour of Apollo; the prætor to have the direction of them, and the decemviri to offer sacrifices after the Grecian rite. The senate ordered that this oracle should be observed the rather, because another of the same Marcus, wherein he had foretold the overthrow at Cannæ, had come true; for this reason they gave the prætor 12,000 ases out of the public cash to defray the solemnity. There were sacrificed an ox to Apollo, as also two white goats, and a cow to Latona; all with their horns gilt. Apollo had also a collection made for him, besides what the people who were spectators gave voluntarily. The first prætor by whom they were held was P. Cornelius Sylla. For some time they were moveable or indictive; but at length were fixed, under P. Licinius Varus, to the fifth of July, and made perpetual. The men, who were spectators at these games, wore garlands on their heads;

Apollinarians, Apollinaris.

the women performed their devotions in the temples at the ſame time, at laſt they carouſed together in the veſtibles of their houſes, the doors ſtanding open. The Apollinarian games were merely ſcenical; and at firſt only obſerved with ſinging, piping, and other ſorts of muſic; but afterwards there were alſo introduced all manner of mountebank-tricks, dances, and the like; yet ſo as that they ſtill remained ſcenical, no chariot races, wreſtling, or the like laborious exerciſes of the body, being ever practiſed at them.

APOLLINARIANS, Apollinarists, called alſo by Epiphanius *Dimaritæ*, ancient hereticks, who denied the proper humanity of Chriſt, and maintained that the body which he aſſumed was endowed with a ſenſitive, and not a rational, ſoul, but that the Divine Nature ſupplied the place of the intellectual principle in man. This ſect derived its name from Apollinaris, biſhop of Laodicea, in the fourth century.

The Apollinarians have been charged with other opinions, ſuch as, the Millenarian and Sabellian, the pre-exiſtence of the body of Chriſt, and the paſſion of his Deity: but eccleſiaſtical writers are not agreed with reſpect to theſe and other particulars. Their doctrine was firſt condemned by a council of Alexandria in the year 362, and afterwards in a more formal manner by a council at Rome in 375; and by another council in 378, which depoſed Apollinaris from his biſhopric. Notwithſtanding all, his doctrine ſpread through moſt of the churches of the eaſt; and his followers were ſubdivided into various ſects. In 388, the emperor Theodoſius enacted a law, forbidding them to hold aſſemblies, to have any eccleſiaſtics or biſhops, or to dwell in cities. The rigorous execution of this law, in concurrence with the decrees of different councils, reduced them to a very ſmall number, and their doctrine had no long duration.

APOLLINARIS (Caius Sulpicius), a very learned grammarian, born at Carthage, lived in the 2d century, under the Antonines; he is ſuppoſed to be the author of the verſes which are prefixed to the comedies of Terence, and contain the arguments of them. He had for his ſucceſſor in the profeſſion of grammar Helvius Pertinax, who had been his ſcholar, and was at laſt emperor.

Apollinaris Sidonius (Caius Lollius), an eminent Chriſtian writer and biſhop in the 5th century, was born of a noble family in France. He was educated under the beſt maſters, and made a prodigious progreſs in the ſeveral arts and ſciences, but particularly in poetry and polite literature. After he had left the ſchools, he applied himſelf to the profeſſion of war. He married Papianilla, the daughter of Avitus, who was conſul, and aftewards emperor, by whom he had three children. But Majorianus in the year 457 having deprived Avitus of the empire, and taken the city of Lyons, in which our author reſided, Apollinaris fell into the hands of the enemy. However, the reputation of his learning ſoftened Majorianus's reſentments, ſo that he treated him with the utmoſt civility, in return for which Apollinaris compoſed a panegyric to his honour; which was ſo highly applauded, that he had a ſtatue erected to him at Rome, and was honoured with the title of *Count*. In the year 467 the emperor Anthemius rewarded him for the panegyric, which he had written in honour of him, by raiſing him to the poſt of governor of Rome, and afterwards to the dignity of a patrician and ſenator, and erecting a ſtatue to him. But he ſoon quitted theſe ſecular employments for the ſervice of the church. The biſhopric of Clermont being vacant in 472 by the death of Eparchus, Apollinaris, who was then only a layman, was choſen to ſucceed him without any intereſt or ſolicitation on his part, in which ſee he acted with the greateſt integrity. Clermont being beſieged by the Goths, he animated the people to the defence of that city, and would never conſent to the ſurrender of it; ſo that, when it was taken about the year 480, he was obliged to retire; but he was ſoon reſtored by Evariges king of the Goths, and continued to govern the church as he had done before. He died in peace the 21ſt of Auguſt 487; and his feſtival is ſtill obſerved in the church of Clermont, where his memory is had in great veneration. He is eſteemed the moſt elegant writer of his age, both in proſe and verſe. He wrote a great many little pieces; but preſerved none but thoſe which he thought were worthy of being continued down to poſterity. He collected himſelf the nine books which we have remaining of his letters. His chief pieces in poetry are the three panegyrics upon the emperors Avitus, Majorianus, and Anthemius. The reſt of them are a collection of poems addreſſed to his friends upon particular ſubjects. His letters contain a variety of particulars relating to polite literature and profane hiſtory.

Apollinarius, Apollo.

APOLLINARIUS (Claudius), a learned biſhop of Hierapolis, who, about the year 170, preſented to Marcus Aurelius an excellent Apology for the Chriſtians.

Apollinarius the Younger, thus called to diſtinguiſh him from his father, called *Apollinarius the Elder*, was at firſt lector or reader of Laodicea, and afterwards biſhop of that city. He was univerſally eſteemed the greateſt man of his age, both for learning and piety, and a moſt accurate and nervous defender of the faith againſt all it enemies: but notwithſtanding this on his advancing ſome opinions that were not approved, he was anathematized as an heretic by the ſecond general council of Conſtantinople in 381.

APOLLO, in mythology, a Pagan deity worſhipped by the Greeks and Romans. Cicero mentions four of his name: the moſt ancient of whom was the ſon of Vulcan; the ſecond a ſon of Corybas, and born in Crete; the third an Arcadian, called *Nomian*, from his being a great legiſlator; and the laſt, to whom the greateſt honour is aſcribed, the ſon of Jupiter and Latona.

Apollo had a variety of other names, either derived from his principal attributes, or the chief places where he was worſhipped. He was called the *Healer* from his enlivening warmth and cheering influence; *Pæan*, from the peſtilential heats: to ſignify the former, the antients placed the graces in his right hand; and for the latter, a bow and arrows in his left: *Nomius*, or the ſhepherd, from his fertilizing the earth, and thence ſuſtaining the animal creation: *Delius*, from his rendering all things manifeſt: *Pythius*, from his victory over Python; *Lycias*, *Phœbus*, and *Phaneta*, from his purity and ſplendor. As Apollo is almoſt always confounded by the Greeks with the ſun, it is no wonder that he ſhould be dignified with ſo many attributes. It was natural for the moſt glorious object in nature, whoſe influence is felt by all creation, and ſeen by eve-

Apollo. ry animated part of it, to be adored as the fountain of light, heat, and life. The power of healing diseases being chiefly given by the ancients to medicinal plants and vegetable productions, it was natural to exalt into a divinity the visible cause of their growth. Hence he was also styled the *God of Physic*; and that external heat which cheers and invigorates all nature, being transferred from the human body to the mind, gave rise to the idea of all mental effervescence coming from this god; hence, likewise, poets, prophets, and musicians are said to be *numine afflati*, inspired by Apollo.

Whether Apollo was ever a real personage, or only the great luminary, many have doubted. Indeed, Vossius has taken great pains to prove this god to be only a metaphorical being, and that there never was any other Apollo than the sun. "He was styled the *Son of Jupiter* (says this author), because that god was reckoned by the ancients the author of the world. His mother was called *Latona*, a name which signifies *hidden*; because, before the sun was created, all things were wrapped up in the obscurity of chaos. He is always represented as beardless and youthful, because the sun never grows old or decays. And what else can his bow and arrows imply, but his piercing beams?" And adds, "that all the ceremonies which were performed to his honour, had a manifest relation to the great source of light which he represented. Whence (he concludes) it is vain to seek for any other divinity than the sun, which was adored under the name of Apollo." However, though this be in general true, yet it does appear, from many passages in ancient authors, that there was some illustrious personage named *Apollo*, who, after his apotheosis, was taken for the sun; as Osiris and Orus in Egypt, whose existence cannot be called in question, were, after their death, confounded with the sun, of which they became the symbols, either from the glory and splendor of their reigns, or from a belief that their souls had taken up their residence in that luminary.

Of the four Apollos mentioned by Cicero, it appears that the three last were Greeks, and the first an Egyptian; who according to Herodotus, was the son of Osiris and Isis, and called *Orus*. Pausanias is of the same opinion as Herodotus, and ranks Apollo among the Egyptian divinities. The testimony of Diodorus Siculus is still more express; for in speaking of Isis, after saying that she had invented the practice of medicine, he adds, that she taught this art to her son Orus, named *Apollo*, who was the last of the gods that reigned in Egypt.

It is easy to trace almost all the Grecian fables and mythologies from Egypt. If the Apollo of the Greeks was said to be the son of Jupiter, it was because Orus the Apollo of the Egyptians had Osiris for his father, whom the Greeks confounded with Jupiter. If the Greek Apollo was reckoned the god of eloquence, music, medicine, and poetry, the reason was, that Osiris, who was the symbol of the sun among the Egyptians, as well as his son Orus, had there taught those liberal arts. If the Greek Apollo was the god and conductor of the muses, it was because Osiris carried with him in his expedition to the Indies singing women and musicians. This parallel might be carried on still further; but enough has been said to prove that the true Apollo was that of Egypt. Apollo.

To the other perfections of this divinity the poets have added beauty, grace, and the art of captivating the ear and the heart, no less by the sweetness of his eloquence, than by the melodious sounds of his lyre. However, with all these accomplishments, he had not the talent of captivating the fair, with whose charms he was enamoured. But the amours and other adventures related of this god during his residence on earth, are too numerous, and too well known, to be inserted here. His musical contests, however, being more connected with the nature of this work, must not be wholly unnoticed.

To begin, therefore, with the dispute which he had with Pan, that was left to the arbitration of Midas.

Pan, who thought he excelled in playing the flute, offered to prove that it was an instrument superior to the lyre of Apollo. The challenge was accepted; and Midas, who was appointed the umpire in this contest, deciding in favour of Pan, was rewarded by Apollo, according to the poets, with the ears of an ass, for his stupidity.—This fiction seems founded upon history. Midas, according to Pausanias, was the son of Gordias and Cybele; and reigned in the Greater Phrygia, as we learn from Strabo. He was possessed of such great riches, and such an inordinate desire of increasing them by the most contemptible parsimony, that, according to the poets, he converted whatever he touched into gold. However, his talent for accumulation did not extend to the acquirement of taste and knowledge in the fine arts; and, perhaps, his dulness and inattention to these provoked some musical poets to invent the fable of his decision in favour of Pan against Apollo. The scholiast upon Aristophanes, to explain the fiction of his long ears, says, that it was designed to intimate that he kept spies in all parts of his dominions.

Marsyas, another player on the flute, was still more unfortunate than either Pan, or his admirer Midas. This Marsyas, having engaged in a musical dispute with Apollo, chose the people of Nysa for judges. Apollo played at first a simple air upon his instrument; but Marsyas, taking up his pipe, struck the audience so much by the novelty of its tone, and the art of his performance, that he seemed to be heard with more pleasure than his rival. Having agreed upon a second trial of skill, it is said that the performance of Apollo, by accompanying the lyre with his voice, was allowed greatly to excel that of Marsyas upon the flute alone. Marsyas, with indignation, protested against the decision of his judges; urging that he had not been fairly vanquished according to the rules stipulated, because the dispute was concerning the excellence of their several instruments, not their voices; and that it was wholly unjust to employ two arts against one.

Apollo denied that he had taken any unfair advantages of his antagonist, since Marsyas had employed both his mouth and fingers in performing upon his instrument; so that, if he was denied the use of his mouth, he would be still more disqualified for the contention. The judges approved of Apollo's reasoning, and ordered a third trial. Marsyas was again vanquished; and Apollo, inflamed by the violence of the dispute, flea'd him alive for his presumption. See Marsyas.

Pan-

Apollo.

Pausanias relates a circumstance concerning this contest, that had been omitted by Diodorus, which is, that Apollo accepted the challenge from Marsyas, upon condition that the victor should use the vanquished as he pleased.

Diodorus informs us, that Apollo, soon repenting of the cruelty with which he had treated Marsyas, broke the strings of the lyre, and by that means put a stop, for a time, to any farther progress in the practice of that new instrument.

The next incident to be mentioned in the history of Apollo is his defeat of the serpent Python.

The waters of Deucalion's deluge, says Ovid, which had overflowed the earth, left a slime, from whence sprung innumerable monsters; and among others the serpent Python, which made great havoc in the country about Parnassus. Apollo, armed with his darts, put him to death; which, physically explained, implies, that the heat of the sun having dissipated the noxious steams, those monsters soon disappeared: or, if this fable be referred to history, the serpent was a robber, who haunting the country about Delphos, and very much infesting those who came thither to sacrifice; a prince, who bore the name of Apollo, or one of the priests of that god put him to death.

This event gave rise to the institution of the Pythian games, so frequently mentioned in the Grecian history; and it was from the legend of Apollo's victory over the Python that the god himself acquired the name of *Pythius*, and his priestess that of PYTHIA. The city of Delphos, where the famous oracles were so long delivered, was frequently styled *Pytho*.

As Apollo was the god of the fine arts, those who cultivated them were called *his sons*. Of this number was Philammon of Delphos, whom the poets and mythologists make the twin-brother of Autolychus, by the nymph Chione, and Apollo and Mercury. It is pretended that both these divinities were favoured by the nymph on the same day, and that their sires were known from their different talents. Philammon, a great poet and musician, was reported to be the offspring of the god who presides over those arts; and Autolychus, from the craftiness and subtility of his disposition, was said to have sprung from Mercury, god of theft and fraud. Philammon is one of the first, after Apollo, upon fabulous record, as a vocal performer, who accompanied himself with the sound of the lyre: his son was the celebrated Thamyris. See THAMYRIS.

There can be no doubt but that Apollo was more generally revered in the Pagan world than any other deity; having, in almost every region of it, temples, oracles, and festivals, as innumerable as his attributes: the wolf and hawk were consecrated to him, as symbols of his piercing eyes; the crow and the raven, because these birds were supposed to have by instinct the faculty of prediction; the laurel, from a persuasion that those who slept with some branches of that tree under their heads received certain vapours, which enabled them to prophesy. The cock was consecrated to him, because by his crowing he announces the rising of the sun; and the grasshopper on account of his singing faculty, which was supposed to do honour to the god of music. Most of the ancient poets have celebrated this tuneful insect, but none better than Anacreon, Ode 43.

Plato says that the grasshopper sings all summer without food, like those men who, dedicating themselves to the muses, forget the common concerns of life.

Apollo.

The swan was regarded by the ancients as a bird sacred to Apollo in two capacities; first, as being, like the crow and raven, gifted with the spirit of prediction; and, secondly, for his extraordinary vocal powers. The sweetness of his song, especially at the approach of death, was not only extolled by all the poets of antiquity, but by historians, philosophers, and sages; and to call a great writer the *swan* of his age and nation, was a full acknowledgment of his sovereignty*. Thus Horace calls Pindar *the Theban swan*.

* See the article *Anas*

Plutarch, who was himself a priest of Apollo, impressed with the highest respect and veneration for him and for music, in his dialogue upon that art, makes one of his interlocutors say, that an invention so useful and charming could never have been the work of man, but must have originated from some god, such as Apollo, the inventor of the flute and lyre, improperly attributed to Hyagnis. Marsyas, Olympus, and others; and the proofs he urges in support of this assertion, show, if not its truth, at least that it was the common and received opinion.

All dances and sacrifices, says he, used in honour of Apollo, are performed to the sound of flutes: the statue of this god at Delos, erected in the time of Hercules, had in its right-hand a bow; and on the left stood the three graces, who were furnished with three kinds of instruments; the lyre, the flute, and the syrinx. The youth also, who carries the laurel of Tempe to Delphos, is accompanied by one playing on the flute; and the sacred presents formerly sent to Delos by the Hyperboreans, were conducted thither to the sound of lyres, flutes, and shepherds pipes. He supports these facts by the testimonies of the poets Alcæus, Alcmon, and Corinna.

It seems as if the account of Apollo could not be concluded by any thing that is left to offer on the subject, so properly, as by part of the celebrated hymn of Callimachus, which during many ages was performed and heard by the most polished people on the globe, with the utmost religious zeal, at the festivals instituted to this god.

Ha! how the laurel, great APOLLO's tree,
And all the cavern, shakes! Far off, far off,
The man that is unhallow'd: for the god
Approaches. Hark! he knocks: the gates
Feel the glad impulse; and the sever'd bars
Submissive clink against their brazen portals.
Why do the Delian palms incline their boughs,
Self-mov'd; and hov'ring swans, their throats releas'd
From native silence, carol sounds harmonious?
  Begin, young men, the hymn: let all your harps
Break their inglorious silence; and the dance,
In mystic numbers trod, explain the music.
But first by ardent pray'r, and clear lustration,
Purge the contagious spots of human weakness:
Impure no mortal can behold Apollo.
So may you flourish, favour'd by the god,
In youth with happy nuptials, and in age
With silver hairs, and fair descent of children;
So lay foundations for aspiring cities,
And bless your spreading colonies' increase.
  Pay sacred rev'rence to Apollo's song;
Lest watchful the far-shouting god emit
His fatal arrows. Silent, Nature stands;
And seas subside, obedient to the sound
Of Io! Io Pæan! nor dares Thetis
Longer bewail her lov'd Achilles' death;

For Phœbus was his foe. Nor must sad Niobe
In fruitless sorrow persevere, or weep
Even thro' the Phrygian marble. Hapless mother!
Whose fondness could compare her mortal offspring
To those which fair Latona bore to Jove.
Io! again repeat ye, Io Pæan!

Recite Apollo's praise till night draws on,
The ditty still unfinish'd; and the day
Unequal to the godhead's attributes
Various, and matter copious of your songs.
Sublime at Jove's right-hand Apollo sits,
And thence distributes honour, gracious king,
And theme of verse perpetual. From his robe
Flows light ineffable! his harp, his quiver,
And Lactian bow, are gold: with golden sandals
His feet are shod. How rich! how beautiful!
Beneath his steps the yellow min'ral rises;
And earth reveals her treasures. Youth and beauty
Eternal deck his cheek: from his fair head
Perfumes distil their sweets; and cheerful Health,
His duteous hand-maid, through the air improv'd
With lavish hand diffuses scent ambrosial.
The spearman's arm by thee, great god, directed,
Sends forth a certain wound. The laurel'd bard,
Inspir'd by thee, composes verse immortal.
Taught by thy art divine, the sage physician
Eludes the urn, and chains or exiles death.

Perpetual fires shine hallow'd on thy altars,
When annual the Carnean feast is held:
The warlike Libyans, clad in armour, lead
The dance; with clanging swords and shields they beat
The dreadful measure: In the chorus join
Their women; brown, but beautiful: such rites
To thee well pleasing ————————
———————— The monstrous Python
Durst tempt thy wrath in vain; for dead he fell,
To thy great strength and golden arms unequal.
Io! while thy unerring hand elanc'd
Another and another dart, the people
Joyfully repeated *Io! Io Pæan!*
Elance the dart, Apollo; for the safety
And health of man, gracious thy mother bore thee!

PRIOR.

Apollo-Belvidere, one in the first class of the ancient statues. The excellence of this statue consists in the expression of something divine, whereas the rest excel only in things that are common to men. This statue may perhaps justly enough claim the preference, even in the superior and distinguished class of the best remains of all antiquity. There are about twenty ancient statues which the moderns have discovered that are referred to the first class, and considered each as the chief beauty in its kind.

APOLLODORUS, born at Damascus, a famous architect under Trajan and Hadrian. He had the direction of the bridge of stone which Trajan ordered to be built over the Danube in the year 104, which was esteemed the most magnificent of all the works of that emperor. Hadrian, one day as Trajan was discoursing with this architect upon the buildings he had raised at Rome, would needs give his judgment, and showed he understood nothing of the matter. Apollodorus turned upon him bluntly, and said to him, Go paint citruls, for you are very ignorant of the subject we are talking upon. Hadrian at this time boasted of his painting citruls well. This insult cost Apollodorus his life.

APOLLODORUS, a celebrated painter of Athens, about 408 years before the birth of Christ, was the first who invented the art of mingling the colours, and of expressing the lights and shades. He was admired also for his judicious choice of subjects, and for the beauty and strength of colouring surpassed all the masters that went before him. He excelled likewise in statuary.

APOLLODORUS the Athenian, a famous grammarian, the son of Asclepiades and disciple of Aristarchus. He wrote many works not now extant; but his most famous production was his Bibliotheca, concerning the origin of the gods. This work consisted of 24 books, but only three are now in being. Several other pieces of his are to be found in Fabricius's *Bibliotheca Græca*. There were various other persons of this name. Scipio Testi, a Neapolitan, has written a treatise of the Apollodoruses, which was printed at Rome in 1555; and Dr Thomas Gale published a work of the same kind in 1675.

APOLLONIA, the name of several ancient cities, particularly of a colony of the Milesians in Thrace, from which Lucullus took away a colossus of Apollo, and placed in the capitol. The greatest part of the town was situated in a small island on the Euxine, in which was a temple of Apollo (Strabo). Pliny says the colossus was 30 cubits high, and cost 500 talents. There was also an Apollonia at mount Parnassus, near Delphi. (Stephanus). Troezen was formerly called *Apollonia*.

APOLLONIA, feasts sacred to Apollo, instituted upon the following occasion. Apollo, having vanquished Python, went with his sister Diana to Ægialea; but, being driven from thence, he removed to the island Crete. The Ægialeans were soon after visited with a plague; upon which, consulting the soothsayers, they were ordered to send seven young men and as many virgins, to appease those deities and bring them back into their country. Apollo and Diana being thus appeased, returned to Ægialea: in memory of which, they dedicated a temple to Pitho, the *goddess of persuasion;* whence a custom arose of choosing every year seven young men, and as many virgins, to go as it were in search of Apollo and Diana.

APOLLONIA, in geography, a promontory of Africa, upon the coast of Guinea, near the mouth of the river Mancu.

APOLLONIUS, the author of the *Argonautics*, and surnamed *The Rhodian*, from the place of his residence, is supposed to have been a native of Alexandria, where he is said to have recited some portion of his poem while he was yet a youth. Finding it ill received by his countrymen, he retired to Rhodes; where he is conjectured to have polished and completed his work, supporting himself by the profession of rhetoric, and receiving from the Rhodians the freedom of their city. He at length returned, with considerable honour, to the place of his birth; succeeding Eratosthenes in the care of the Alexandrian library in the reign of Ptolemy Euergetes, who ascended the throne of Egypt the year before Christ 246. That prince had been educated by the famous Aristarchus, and rivalled the preceding sovoreigns of his liberal family in the munificent encouragement of learning. Apollonius was a disciple of the poet Callimachus; but their connection ended in the most violent enmity, which was probably owing to some degree of contempt expressed by Apollonius for the light compositions of his master. The learned have vainly endeavoured to discover the particulars of their quarrel.—The only work of Apollonius which has descended to modern times is his poem above-mentioned, in four books, on the Argonautic expedition.

Apollonius, Apollos.

expedition. Both Longinus and Quintilian have assigned to this work the mortifying character of mediocrity: "But (says Mr Hayley) there lies an appeal from the sentence of the most candid and enlightened critics to the voice of Nature; and the merit of Apollonius has little to apprehend from the decision of this ultimate judge. His poems abound in animated description, and in passages of the most tender and pathetic beauty. How finely painted is the first setting forth of the Argo! and how beautifully is the wife of Chiron introduced, holding up the little Achilles in her arms, and showing him to his father Peleus as he sailed along the shore! But the chief excellence in our poet, is the spirit and delicacy with which he has delineated the passion of love in his Medea. That Virgil thought very highly of his merit in this particular, is sufficiently evident from the minute exactness with which he has copied many tender touches of the Grecian poet. Those who compare the third book of Apollonius with the fourth of Virgil, may, I think, perceive not only that Dido has some features of Medea, but that the two bards, however different in their reputation, resembled each other in their genius; and they both excel in delicacy and pathos."—The ancient scholia upon his *Argonautics*, still extant, are extremely useful, and full of learning.

Apollonius of Perga, a city of Pamphylia, was a great geometrician, under the reign of Ptolemy Euergetes, which reaches from the 2d year of the 133d Olympiad to the 3d year of the 139th. He studied a long time at Alexandria, under the disciples of Euclid; and composed several works, of which that only of the Conics remains.

Apollonius, a Pythagorean philosopher, born at Tyana in Cappadocia, about the begining of the first century. At 16 years of age he became a strict observer of Pythagoras's rules, renouncing wine, women and all sorts of flesh; not wearing shoes, letting his hair grow, and wearing nothing but linen. He soon after set up for a reformer of mankind, and chose his habitation in a temple of Æsculapius, where he is said to have performed many wonderful cures. Philostratus has wrote the life of Apollonius, in which there are numberless fabulous stories recounted of him. We are told that he went five years without speaking; and yet during this time, that he stopped many seditions in Cicilia and Pamphylia: that he travelled, and set up for a legislator; and that he gave out he understood all languages, without having ever learned them: that he could tell the thoughts of men, and understood the oracles which birds gave by their singing. The Heathens were fond of opposing the pretended miracles of this man to those of our Saviour; and by a treatise which Eusebius wrote against one Hierocles, we find that the drift of the latter, in the treatise which Eusebius refutes, seems to have been to draw a parallel betwixt Jesus Christ and Apollonius, in which he gives the preference to this philosopher. Mr Du Pin has wrote a confutation of Philostratus's life of Apollonius.

Apollonius wrote some works; viz. four books of Judicial astrology; a treatise upon the sacrifices, showing what was proper to be offered to each diety; and a great number of letters; all of which are now lost.

APOLLOS, in Scripture-history, a Jew of Alexandria, who came to Ephesus during the absence of St Paul, who was gone to Jerusalem (Acts xviii. 24.) Apollos was an eloquent man, and well versed in the Scriptures; and as he spoke with zeal and fervour, he taught diligently the things of God: but knowing only the baptism of John, he was no more than a catechumen, or one of the lowest order of Christians, and did not as yet distinctly know the mysteries of the Christian doctrine. However, he knew that Jesus Christ was the Messiah, and declared himself openly to be his disciple. When therefore he was come to Ephesus, he began to speak boldly in the synagogue, and to show that Jesus was the Christ. Aquila and Priscilla having heard him, took him home with them; instructed him more fully in the ways of God; and baptized him, probably in the name of Jesus Christ.

Apollyon, Apologetic.

Some time after this he had a mind to go into Achaia; and the brethren having exhorted him to undertake this journey, they wrote to the disciples, desiring them to receive him. He arrived at Corinth; and was there very useful in convincing the Jews out of the Scriptures, and demonstrated to them that Jesus was the Christ. Thus he watered what St Paul had planted in this city (1 Cor. iii. 6.): but the great fondness which his disciples had for his person had like to have produced a schism; some "saying, I am of Paul; others, I am of Apollos, I am of Cephas." However, this division, which St Paul speaks of in the chapter last quoted, did not prevent that apostle and Apollos from being closely united by the bands of charity. Apollos hearing that the Apostle was at Ephesus, went to meet him, and was there when St Paul wrote the first epistle to the Corinthians; wherein he testifies, that he had earnestly entreated Apollos to return to Corinth, but hitherto had not been able to prevail with him; that, neverthelefs, he gave him room to hope that he would go when he had an opportunity. St Jerom says, that Apollos was so dissatisfied with the division which had happened upon his account at Corinth; that he retired into Crete with Zena, a doctor of the law; and that this disturbance having been appeased by the letter which St Paul wrote to the Corinthians, Apollos returned to this city, and was bishop thereof. The Greeks make him bishop of Duras; others say, he was bishop of Iconium in Phrygia; and others, that he was bishop of Cæsarea.

APOLLYON, a Greek word that signifies *the destroyer*, and answers to the Hebrew *Abaddon*. St John in the Revelations (ix. 11.) says, that an angel having opened the bottomless pit, a thick smoke issued out of it; and with this smoke locusts, like horses, prepared for battle, and commanded by the angel of the bottomless pit, called in Hebrew *Abaddon*, but in the Greek *Apollyon*.

APOLOGETIC, Apologetical, something said or written, by way of excuse or apology, for any action or person.

The Apologetic of Tertullian is a work full of strength and spirit. He there vindicates the Christians from all that had been objected to them; particularly from the abominable crimes said to be perpetrated at their meetings, and their want of love and fidelity to their country. The ground of this last accusation was, their refusing to take the accustomed oaths, and swear by the tutelary gods of the empire.—Tertullian addresses

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dreſſes his Apologetic to the magiſtrates of Rome, the emperor Severus being then abſent.

APOLOGUE, in matters of literature, an ingenious method of conveying inſtruction by means of a feigned relation called a *moral fable*.

The only difference between a parable and an apologue is, that the former, being drawn from what paſſes among mankind, requires probability in the narration; whereas the apologue, being taken from the ſuppoſed actions of brutes, or even of things inanimate, is not tied down to the ſtrict rules of proprobability. Æſop's fables are a model of this kind of writing.

APOLOGY, a Greek term, literally importing an excuſe or defence of ſome perſon or action.

APOMELI, among ancient phyſicians, a decoction of honey and vinegar, much uſed as a detergent, promoter of ſtool, urine, &c.

APOMYOS DEUS, (ἀπὸ, and μυῖα *fly*,) in the Heathen mythology, a name under which Jupiter was worſhipped at Elis, and Hercules as well as Jupiter at the Olympic games. Theſe deities were ſupplicated under this name, to deſtroy or drive away the vaſt number of flies which always attended at the great ſacrifices; and in thoſe which accompanied the Olympic games, the firſt was always to the Apomyos, or Myiagrus, Deus, that he might drive away the flies from the reſt. The uſual ſacrifice was a bull.

APONEUROSIS, among phyſicians, a term ſometimes uſed to denote the expanſion of a nerve or tendon in the manner of a membrane; ſometimes for the cutting off a nerve; and, finally, for the tendon itſelf.

APONO (Peter d'), one of the moſt famous philoſophers and phyſicians of his age, born in the year 1250, in a village about four miles from Padua. He ſtudied ſome time at Paris, and was there promoted to the degree of doctor in philoſophy and phyſic. When he came to practiſe as a phyſician, he is ſaid to have inſiſted on very large ſums for his viſits: we are not told what he demanded for the viſits he made in the place of his reſidence; but it is affirmed, that he would not attend the ſick in any other place under 150 florins a-day; and when he was ſent for by Pope Honorius IV. he demanded 400 ducat's for each day's attendance. He was ſuſpected of magic, and proſecuted by the Inquiſition on that account. "The common opinion of almoſt all authors (ſays Naude) is, that he was the greateſt magician of his age; that he had acquired the knowledge of the ſeven liberal arts, by means of the ſeven familiar ſpirits, which he kept incloſed in a cryſtal; and that he had the dexterity to make the money he had ſpent come back into his purſe." The ſame author adds, that he died before the proceſs againſt him was finiſhed, being then in the 80th year of his age; and that, after his death, they ordered him to be burnt in effigy, in the public place of the city of Padua: deſigning thereby to ſtrike a fear into others of incurring the like puniſhment; and to ſuppreſs the reading three books which he had wrote; the firſt being the Heptameron, which is printed at the end of the firſt volume of Agrippa's work; the ſecond, that which is called by Trithemius, *Elucidarium necromanticum Petri de Albano*; and the laſt, that which is intitled by the ſame author, *Liber experimentorum mirabilium de annulis ſecundum xxviii. manſiones lunæ*. His body being ſecretly taken up by his friends, eſcaped the vigilance of the inquiſitors, who would have burnt it. It was removed ſeveral times, and was at laſt placed in the church of St Auguſtin, without an epitaph or any mark of honour. The moſt remarkable book which Apono wrote, was that which procured him the ſirname of *Conciliator*; he wrote alſo a piece intitled *De medicina omnimoda*. There is a ſtory told of him, that, having no well in his houſe, he cauſed his neighbour's to be carried into the ſtreet by devils, when he heard they had forbidden his maid fetching water there. He had much better (ſays Mr Bayle) have employed the devils to make a well in his own houſe, and have ſtopped up his neighbour's; or, at leaſt, tranſported it into his houſe, rather than into the ſtreet.

APONOGETON: A genus of the digynia order, belonging to the heptandria claſs of plants, which has no Engliſh name. The calyx is an oblong omentum; there is no corolla; and the capſulæ are three-ſeeded. There are two ſpecies, natives of the Indies.

APONUS, a hamlet near Patavium, with warm baths. It was the birth-place of Livy, (Martial); and is now called *Albano*. E. Long. 10. N. Lat. 45. 15.

APOPEMPTIC, in the ancient poetry, a hymn addreſſed to a ſtranger on his departure from a place to his own country. The ancients had certain holidays, wherein they took leave of the gods with *apopemptic* ſongs, as ſuppoſing them returning each to his own country. The deities having the patronage of divers places, it was but juſt to divide their preſence, and allow ſome time to each. Hence it was, that among the Delians and Mileſians we find feaſts of Apollo, and among the Argians feaſts of Diana, called *Epidemiæ*, as ſuppoſing theſe deities then more peculiarly reſident among them. On the laſt day of the feaſt they diſmiſſed them, following them to the altars with *apopemptic* hymns.

APOPHASIS, a figure in rhetoric, by which the orator, ſpeaking ironically, ſeems to wave what he would plainly inſinuate: as, *Neither will I mention thoſe things, which, if I ſhould, you notwithſtanding could neither confute nor ſpeak againſt them.*

APOPHLEGMATIZANTS, in pharmacy, medicines proper to clear the head from ſuperfluous phlegm, whether by ſpitting or by the noſe.

APOPHTHEGM, a ſhort, ſententious, and inſtructive remark, pronounced by a perſon of diſtinguiſhed character. Such is that of Cyrus: *He is unworthy to be a magiſtrate, who is not better than his ſubjects.* Or this: *He that will not take care of his own buſineſs, will be forced to take care of that of others.* Or that of Artaxerxes Mnemon, when reduced to hunger by the loſs of his baggage: *How much pleaſure have I hitherto lived a ſtranger to?* Or that of Cato, *Homines nihil agendo diſcunt male agere.* Or, finally, that of Auguſtus, *Feſtina lente.* The apophthegms of Plutarch are well known.

APOPHYGE, in architecture, a concave part or ring of a column, lying above or below the flat member. The French call it *le conge d'en bas*, or *d'en haut*: the Italians, *cavo di baſſo*, or *di ſopra*; and alſo *il vivo di baſſo*. The apophyge originally was no more than

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the ring or ferril, at first fixed on the extremities of wooden pillars, to keep them from splitting; which afterwards was imitated in stone.

APOPHYSIS, in anatomy, a process or protuberance of a bone. See ANATOMY.

APOPLEXY, a distemper in which the patient is suddenly deprived of all his senses, and of voluntary motion. See MEDICINE-*Index*.

APORIA, is a figure in rhetoric, by which the speaker shows, that he doubts where to begin for the multitude of matter, or what to say in some strange and ambiguous thing; and doth, as it were, argue the case with himself. Thus Cicero says, *Whether he took them from his fellows more impudently, gave them to a harlot more lasciviously, removed them from the Roman people more wickedly, or altered them more presumptuously, I cannot well declare.*

APORON, or APORIME, a problem difficult to resolve, and which has never been resolved, though it be not, in itself, impossible.

The word is derived from απορος, which signifies something very difficult, and impracticable; being formed from the privative α and πορος, *passage*. Such we conceive the quadrature of the circle; the duplicature of the cube; the trisection of an angle, &c. When a question was proposed to any of the Greek philosophers, especially of the sect of Academists; if he could not give a solution, his answer was, Απορεω, *I cannot see through it*.—This word is also used by some law writers for an inexplicable speech or discourse.

APOSIOPESIS, in rhetoric, otherwise called *reticency*, and *suppression*; a figure, by which a person really speaks of a thing, at the same time that he makes a show as if he would say nothing of it. The word comes from αποσιωπαω, *I am silent*.—It is commonly used to denote the same with ELLIPSIS. Jul. Scaliger distinguishes them. The latter, according to him, being only the suppression of a word; as, *me, me; adsum qui feci:* the former: the omitting to relate some part of the action; as,

> *Dixerat, atque illam media inter talia ferro*
> *Collapsam adspiciunt*————————

where the poet does not mention how Dido killed herself.—This figure is of use to keep up the grandeur and sublimity of a discourse.

APOSPHRAGISMA, (from απο σφραγιζω, *I seal*,) in antiquity, the figure and impression of a seal.—It was forbid among the ancients to have the figure or image of God on their rings and seals. To this purpose the precept of Pythagoras, Εν δακτυλιω εικονα Θεȣ μη περιφερειν! But in process of time, this was little regarded; it was usual enough to have the figures of Egyptian and other deities, as well as of heroes, monsters, friends, ancestors, and even brutes, on their *dactyli*, or ring-seals. Thus Cæsar had the image of Venus, Pollio of Alexander, Augustus of the *sphinx*, Pompey of a frog, Lentulus of his grandfather, &c.

APOSTACY, the abandoning the true religion. The primitive Christian church distinguished several kinds of apostacy. The first, of those who went over entirely from Christianity to Judaism; the second, of those who mingled Judaism and Christianity together; and the third, of those who complied so far with the Jews as to communicate with them in many of their unlawful practices, without making a formal profession of their religion. But the fourth sort was of those who, after having been some time Christians, voluntarily relapsed into Paganism.

The perversion of a Christian to Judaism, Paganism or other false religions, was punished by the emperors Constantius and Julian with confiscation of goods, to which the emperors Theodosius and Valentinian added capital punishment, in case the apostate endeavoured to pervert others to the same iniquity. A punishment too severe for any temporal laws to inflict; and yet the zeal of our ancestors imported it into this country; for we find by Bracton, that in his time apostates were to be burnt to death. Doubtless the preservation of Christianity, as a national religion, is, abstracted from its own intrinsic truth, of the utmost consequence to the civil state: which a single instance will sufficiently demonstrate. The belief of a future state of rewards and punishments, the entertaining just ideas of the moral attributes of the supreme Being, and a firm persuasion that he superintends and will finally compensate every action in human life (all which are clearly revealed in the doctrines and forcibly inculcated by the precepts, of our saviour Christ), these are the grand foundation of all judicial oaths; which call God to witness the truth of those facts, which perhaps may be only known to him and the party attesting: all moral evidence therefore, all confidence in human veracity, must be weakened by apostacy, and overthrown by total infidelity. Wherefore all affronts to Christianity, or endeavours to depreciate its efficacy, in those who have once professed it, are highly deserving of censure. But yet the loss of life is a heavier penalty than the offence, taken in a civil light, deserves; and, taken in a spiritual light, our laws have no jurisdiction over it. This punishment, therefore, has long ago become obsolete; and the offence of apostacy was for a long time the object only of the ecclesiastical courts, which corrected the offender *pro salute animæ*. But about the close of the last century, the civil liberties to which we were then restored being used as a cloke of maliciousness, and the most horrid doctrine subversive of all religion being publicly avowed both in discourse and writings, it was thought necessary again for the civil power to interpose, by not admitting those miscreants to the privileges of society, who maintained such principles as destroyed all moral obligation. To this end it was enacted by statute 9 and 10 W. III. c. 32. That if any person educated in, or having made profession of, the Christian religion, shall by writing, printing teaching, or advised speaking, deny the Christian religion to be true, or the holy Scriptures to be of divine authority, he shall upon the first offence be rendered incapable to hold any office or place of trust; and, for the second, be rendered incapable of bringing any action, or of being guardian, executor, legatee, or purchaser of lands, and shall suffer three years imprisonment without bail. To give room however for repentance, if, within four months after the first conviction, the delinquent will in open court publicly renounce his error, he is discharged for that once from all disabilities.

APOSTASIS, in medicine, the same with abscess.

APOSTATE, one who deserts his religion. Among the

the Romanists, it signifies a man who, without a legal dispensation, forsakes a religious order of which he had made profession. Hence,

APOSTATA CAPIENDO, in the English law, a writ that formerly lay against a person who, having entered into some order of religion, broke out again, and wandered up and down the country.

A POSTERIORI, or demonstration *à posteriori*. See DEMONSTRATION.

APOSTIL, in matters of literature, the same with a marginal note.

APOSTLE properly signifies a messenger or person sent by another upon some business; and hence, by way of eminence, denotes one of the disciples commissioned by Jesus Christ to preach the gospel.

Our blessed Lord selected twelve out of the number of his disciples to be invested with the apostleship. Their names were Simon Peter, Andrew, James the greater, John, Philip, Bartholomew, Thomas, Matthew, James the less, Jude sirnamed Lebbeus or Thaddeus, Simon the Canaanite, and Judas Iscariot. Of these Simon, Andrew, James the greater, and John, were fishermen; and Matthew a publican, or receiver of the public revenues: of what profession the rest were, we are not told in scripture; though it is probable they were fishermen.

There are various conjectures as to the reason of our Saviour's making choice of *twelve* apostles. The most probable is, that it might be an allusion to the twelve patriarchs, as the founders of their several tribes; or to the twelve chief heads or rulers of those tribes, of which the body of the Jewish nation consisted. This opinion seems to be countenanced by what our Saviour tells his apostles, that "when the Son of man shall sit in the throne of his glory, *they* also shall sit upon twelve thrones judging the twelve tribes of Israel."

Our Lord's first commission to his apostles was in the third year of his public ministry, about eight months after their solemn election; at which time he sent them out by two and two. They were to make no provision of money for their subsistence in their journey, but to expect it from those to whom they preached. They were to declare, that the kingdom of heaven, or the Messiah, was at hand; and to confirm their doctrine by miracles. They were to avoid going either to the Gentiles or to the Samaritans, and to confine their preaching to the people of Israel. In obedience to their Master, the apostles went into all the parts of Palestine inhabited by the Jews, preaching the gospel, and working miracles. The evangelical history is silent as to the particular circumstances attending this first preaching of the apostles; and only informs us, that they returned, and told their Master of all that they had done.

Their second commission, just before our Lord's ascension into heaven, was of a more extensive and particular nature. They were now not to confine their preaching to the Jews, but to "go and teach ALL nations, baptizing them in the name of the Father, and of the Son, and of the Holy Ghost." Accordingly they began publicly, after our Lord's ascension, to exercise the office of their ministry, working miracles daily in proof of their mission, and making great numbers of coverts to the Christian faith. This alarmed the Jewish Sanhedrim; whereupon the apostles were apprehended, and, being examined before the high priest and elders, were commanded not to preach any more in the name of Christ. But this injunction did not terrify them from persisting in the duty of their calling; for they continued daily, in the temple, and in private houses, teaching and preaching the gospel.

After the apostles had exercised their ministry for twelve years in Palestine, they resolved to disperse themselves in different parts of the world, and agreed to determine by lot what parts each should take. According to this division, St Peter went into Pontus, Galatia, and those other provinces of the Lesser Asia. St Andrew had the vast northern countries of Scythia and Sogdiana allotted to his portion. St John's was partly the same with Peter's, namely, the Lesser Asia. St Philip had the Upper Asia assigned to him, with some parts of Scythia and Colchis. Arabia Felix fell to St Bartholomew's share. St Matthew preached in Chaldæa, Persia, and Parthia. St Thomas peached likewise in Parthia; as also to the Hyrcanians, Bactrians, and Indians. St James the less continued in Jerusalem, of which church he was bishop. St Simon had for his portion Egypt, Cyrene, Libya, and Mauritania; St Jude Syria and Mesopotamia; and St Matthias, who was chosen in the room of the traitor Judas, Cappadocia and Colchis. Thus, by the dispersion of the apostles, Christianity was very early planted in a great many parts of the world. We have but very short and imperfect accounts of their travels and actions.

In order to qualify the apostles for the arduous task of converting the world to the Christian religion, they were in the first place, miraculously enabled to speak the languages of the several nations to whom they were to preach: and, in the second place, were endowed with the power of working miracles, in confirmation of the doctrines they taught; gifts which were unnecessary, and therefore ceased, in the after ages of the church, when Christianity came to be established by the civil power.

St Paul is frequently called the *apostle*, by way of eminence; and the *apostle of the Gentiles*, because his ministry was chiefly made use of for the conversion of the Gentile world, as that of St Peter was for the Jews, who is therefore stiled the *apostle of the circumcision*. The several apostles are usually represented with their respective badges or attributes; St Peter with the keys; St Paul with a sword; St Andrew with a cross or saltier; St James minor with a fuller's pole; St John with a cup, and winged serpent flying from it; St Bartholomew with a knife; St Philip with a long staff, whose upper end is formed into a cross; St Thomas with a lance; St Matthew with a hatchet; St Matthias with a battle-ax; St James major with a pilgrim's staff and a gourd-bottle; St Simon with a saw; and St Jude with a club.

This appellation was also given to the ordinary travelling ministers of the church.—Thus St Paul, in the epistle to the Romans, xvi. 7. says, "Salute Andronicus and Junia, my kinsmen and fellow prisoners, who are of note among the apostles." It was likewise a title given to those sent by the churches to carry their alms to the poor of other churches. This usage they borrowed from the synagogues, who called those whom they sent on this message by the same name; and the

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function or office itself αποστολη, *apostole*, q. d. *mission*. Thus St. Paul, writing to the Philippians, tells them, that Epaphroditus their apostle had ministered to his wants, ch. ii. 25.

The appellation is given in like manner to those persons who first planted the Christian faith in any place. Thus Dionysius of Corinth is called the *apostle of France*; Xavier, the *apostle of the Indies*, &c. In the East Indies the Jesuit missionaries are also called *apostles*.

Apostle is also used among the Jews for a kind of officer anciently sent into the several parts and provinces in their jurisdiction, by way of visitor or commissary, to see that the laws were duly observed, and to receive the monies collected for the reparation of the temple, and the tribute payable to the Romans. The Theodosian code, lib. xiv. *De Judæis*, calls those *apostoli, qui ad exigendum aurum atque argentum a patriarcha certo tempore diriguntur*. Julian the apostate remitted the Jews the *apostole*, αποστολη; that is, as he himself explains it, the tribute they had been accustomed to send him. These apostles were a degree below the officers of the synagogues called *patriarchs*, and received their commissions from them. Some authors observe, that St Paul had borne this office; and that it is this he alludes to in the beginning of the epistle to the Galatians: as if he had said, Paul, no longer an apostle of the synagogue, nor sent thereby to maintain the law of Moses, but now an apostle and envoy of Jesus Christ, &c. St Jerom, though he does not believe that St Paul had been an apostle of this kind, yet imagines that he alludes to it in the passage just cited.

Apostle, in the Greek liturgy, is particularly used for a book containing the epistles of St Paul, printed in the order wherein they are to be read in churches, through the course of the year. Another book of the like kind, containing the Gospels, is called Ευαγγελιον, *Gospel*.—The apostle, of late days, has also contained the other canonical epistles, the Acts of the Apostles, and the Revelations. Hence it is also called *Acts of the Apostles*, Πραξαποστολος; that being the first book in it.

Apostle is also thought by many to have been the original name for bishops, before the denomination *bishop* was appropriated to their order. Thus Theodoret says expressly, the same persons were anciently called promiscuously both bishops and presbyters, whilst those who are now called bishops were called *apostles*. In the arsenal of Bremen, there are twelve pieces of cannon called the *Twelve Apostles*, on a supposition that the whole world must be convinced, and acquiesce in the preaching of such apostles.

Apostles' Creed: A *formula*, or summary, of the Christian faith, drawn up, according to Ruffinus, by the apostles themselves; who, during their stay at Jerusalem, soon after our Lord's ascension, agreed upon this *creed*, as a rule of faith, and as a *word of distinction* by which they were to know friends from foes. Baronius, and some other authors, conjecture, that they did not compose it till the second year of the reign of Claudius, a little before their dispersion. As to their manner of composing it, some fancy, that each apostle pronounced his article, which is the reason of its being called *symbolum apostolicum* it, being made up of sentences jointly contributed, after the manner of persons paying each their club (*symbolum*) or share of a reckoning.

But there are reasons which may induce us to question whether the apostles composed any such creed as this. For, first, neither St Luke in the Acts, nor any other ecclesiastical writer before the 5th century, make any mention of an assembly of the apostles in order to the composing of a creed. Secondly, the fathers of the three first centuries, in disputing against heretics, endeavour to prove that the doctrine contained in this creed was the same which the apostles taught; but they never pretend that the apostles composed it. Thirdly, if the apostles had made this creed, it would have been the same in all churches, and in all ages; and all authors would have cited it after the same manner. But the case is quite otherwise. In the second and third ages of the church, there were as many creeds as authors, and one and the same author sets down the creed after a different manner in several places of his works; which is an evidence that there was not at that time any creed which was reputed to be the apostles'. In the 4th century, Ruffinus compares together the three ancient creeds of the churches of Aquileia, Rome, and the East, which differ very considerably in the terms. Besides, these creeds differed not only in the terms and expressions, but even in the articles, some of which were omitted in one or other of them; such as those of the *descent into hell*, the *communion of the saints*, and the *life everlasting*. From these reasons it may be gathered, that tho' this creed may be said to be that of the apostles in regard to the doctrines contained therein, yet it is not to be referred to them as the authors and first composers of it. Who was the true author of it, is not so easy to determine; though its great antiquity may be inferred from hence, that the whole form, as it now stands in the English liturgy, is to be found in the works of St Ambrose and Ruffinus, the former of whom flourished in the 3d century, and the latter in the 4th century.

The primitive Christians, in regard they always concealed this and their other mysteries, did not publicly recite the creed, except at the times of baptism; which, unless in cases of necessity, were only at Easter and Whitsuntide. The constant repeating it was not introduced into the church till the end of the 5th century; about which time Petrus Gnapheus, bishop of Antioch, prescribed the recital of it every time divine service was performed.

APOSTOLARE, Apostolicare, *apostolizing*, in some middle-age writers, denotes the being preferred to the dignity of pope.

APOSTOLATE, in a general sense, is used for mission. In this sense, Olearius has a discourse concerning the apostolate of Christ.

Apostolate more properly denotes the dignity or office of an apostle of Christ; but it is also used, in ancient writers, for the office of a bishop. In this sense we meet with several letters, petitions, requests, &c. directed to bishops under the title of your *apostolate*, or *apostalatus vester*. But as the title *apostolicus* had been appropriated to the pope, so that of *apostolate* became at length restrained to the sole dignity of the popedom. Every bishop's see was anciently dignified with the title of *sedes apostolica*, an apostolical fee, which is now the peculiar denomination of the fee of Rome.

APOSTOLI, in a law, denote those letters missive which are demanded in cases of appeal.

APOSTOLIC, APOSTOLICAL, something that relates to the apostles, or descends from them. Thus we say, the *apostolical* age, *apostolical* doctrine, *apostolical* character, constitutions, traditions, &c.

APOSTOLIC, in the primitive church, was an appellation given to all such churches as were founded by the apostles; and even to the bishops of those churches, as being the reputed successors of the apostles. These were confined to four, viz. Rome, Alexandria, Antioch, and Jerusalem. In after-times, other churches assumed the same quality, on account, principally, of the conformity of their doctrine with that of the churches which were apostolical by foundation, and because all bishops held themselves successors of the apostles, or acted in their dioceses with the authority of apostles.

The first time the term *apostolical* is attributed to bishops, as such, is in a letter of Clovis to the council of Orleans, held in 511, though that king does not there expressly denominate them *apostolical*, but (*apostolica sede dignissimi*) highly worthy of the apostolical see. In 581, Guntram calls the bishops, met at the council of Mason, *apostolical* pontiffs, *apostolici pontifices*.

In progress of time, the bishop of Rome growing in power above the rest, and the three patriarchates of Alexandria, Antioch, and Jerusalem, falling into the hands of the Saracens, the title *apostolical* was restrained to the pope and his church alone. Though some of the popes, and St Gregory the Great, not contented to hold the title by this tenure, began, at length, to insist, that it belonged to them by another peculiar right, as being the successors of St Peter. The country of Rheims in 1049, declared that the pope was the sole apostolical primate of the universal church. And hence a great number of apostolicals; *apostolical* see, *apostolical* nuncio, *apostolical* notary, *apostolical* brief, *apostolical* chamber, *apostolical* vicar, &c.

APOSTOLICAL Constitutions. See CONSTITUTION.

APOSTOLICAL Traditions. See TRADITION.

APOSTOLICAL Fathers is an appellation usually given to the writers of the first century who employed their pens in the cause of Christianity. Of these writers, Cotelerius, and after him Le Clerc, have published a collection in two volumes, accompanied both with their own annotations and the remarks of other learned men.

APOSTOLIANS, a sect of the Mennonites, which first sprung up in the year 1664, and derived its name from Apostool, one of the Mennonite ministers at Amsterdam. They concurred with them in doctrine, and admitted to their communion those only who professed to believe all the sentiments which are contained in their public confession of faith.

APOSTOLICI, or APOSTOLICS, was a name assumed by three different sects, on account of their pretending to imitate the manner and practice of the apostles. The first apostolici, otherwise called *Apotactitæ* and *Apotactici*, rose out of the Encratitæ, and Cathari, in the third century. They made profession of abstaining from marriage, and the use of wine, flesh, money, &c.

Gerhard Sagarelli was the founder of the second sect; he obliged his followers to go from place to place as the apostles did, to wander about cloathed in white, with long beards, dishevelled hair, and bare heads, accompanied with women, whom they called their spiritual sisters. They likewise renounced all kinds of property and possessions, inveighed against the growing corruption of the church of Rome, predicted its overthrow, and the establishment of a purer church on its ruins. Sagarelli was burnt alive at Parma in the year 1300, and was afterwards succeeded by Dulcinus, who added to the character of an apostle those of a prophet and a general, and carried on a bloody and dreadful war for the space of more than two years against Raynerius, bishop of Vercelli; he was at length defeated, and put to death in a barbarous manner in the year 1307. Nevertheless, this sect subsisted in France, Germany, and in other countries, till the beginning of the fifteenth century, when it was totally extirpated under the pontificate of Boniface IX.

The other branch of apostolici were of the twelfth century. These also condemned marriage, preferring celibacy, and calling themselves the chaste brethren and sisters; though each was allowed a spiritual sister, with whom he lived in a domestic relation; and on this account they have been charged with concubinage: they held it unlawful to take an oath; they set aside the use of baptism; and in many things imitated the Manichees. Bernard wrote against this sect of apostolici.

APOSTOLICUM is a peculiar name given to a kind of song or hymn, anciently used in churches. The apostilicum is mentioned by Greg. Thaumaturgus as used in his time. Vossius understands it as spoken of the apostles creed: Suicer thinks this impossible, for that this creed was then unknown in the churches of the east.

APOSTROPHE, in rhetoric, a figure by which a person who is either absent or dead is addressed as if he were present, and attentive to us. This figure is, in boldness, a degree lower than the address to personified objects (see PERSONIFICATION); since it requires a less effort of imagination to suppose persons present who are dead or absent, than to animate insensible beings and direct our discourse to them. The poems of Ossian abound with the most beautiful instances of this figure. "Weep on the rocks of roaring winds, O maid of Inistore! Bend thy fair head over the waves, thou fairer than the ghost of the hills when it moves in a sun-beam at noon over the silence of Morven! He is fallen! Thy youth is low; pale beneath the sword of Cuchullin!"

APOSTROPHE, in grammar, the contraction of a word by the use of a comma: as *call'd* for *called*, *tho'* for *though*.

APOTACTITÆ, or APOTACTICI, an ancient sect, who affecting to follow the evangelical counsels of poverty, and the examples of the apostles and primitive Christians, renounced all their effects and possessions. It does not appear that they gave into any errors during their first state; some ecclesiastical writers assure us they had divers holy virgins and martyrs under the persecution of Dioclesian, in the fourth century; but they afterwards fell into the opinions of the Encratitæ, and taught that the renouncing of all riches was not

only

only a matter of counsel and advice, but of precept and necessity. And hence the sixth law in the Theodosian code joins the Apotactitæ with the Eunomians and Arians.

APOTEICHISMUS, in the ancient military art, a kind of line of circumvallation drawn round a place in order to besiege it. This was also called *periteichismus*. The first thing the ancients went about, when they designed to lay close siege to a place, was the Apoteichismus; which sometimes consisted of a double wall or rampart, raised of earth; the innermost to prevent sudden sallies from the town, the outermost to keep off foreign enemies from coming to the relief of the besieged. This answered to what are called *lines of contravallation* and *circumvallation* among the moderns.

APOTHECARY, one who practises the art of pharmacy. In London, the apothecaries are one of the city-companies. They were incorporated by a charter from king James. I. procured at the solicitation of Dr Mayerne and Dr Aitkens: till that time they only made a part of the grocer's company; plums, sugar, spice, Venice treacle, mithridate, &c. were sold in the same shop and by the same person. The reason of separating them was, that medicines might be be better prepared, and in opposition to divers persons who imposed unwholesome remedies on the people. By an act which was made perpetual in the ninth year of George I. they are exempted from serving upon juries, or in ward and parish offices. They are obliged to make up their medicines according to the formulas prescribed in the college dispensatory; and are liable to have their shops visited by the censors of the college, who are empowered to destroy such medicines as they think not good.

They have a hall in Black Friars, where there are two fine elaboratories, out of which all the surgeons chests are supplied with medicines for the royal British navy.

To his majesty belong two apothecaries: the salary to the first, 320l. to the second, 275l.—To the household belong also two.

The charitable dispensation of medicines by the Chinese is well deserving notice. They have a stone, which is ten cubits high, erected in the public squares of their cities: on this stone are engraved the names of all sorts of medicines with the price of each; and when the poor stand in need of any relief from physic, they go to the treasury, where they receive the price each medicine is rated at.

Apothecary, *Apothecarius*, in writers of the middle age, denotes a shop-keeper, or ware-house keeper.

Apothecarius is also used to denote a store-keeper, or officer appointed to have the direction of a magazine, granary, &c. in which sense *apothecarii* is sometimes rendered by *horearii* and *rationarii*.

APOTHEOSIS, in antiquity, an heathen ceremony, whereby their emperors and great men were placed among the gods. The word is derived from απο, and Θεος, *God*.

After the apotheosis, which the also called *deification* and *consecration*, temples, altars, and images were erected to the new deity; sacrifices, &c. were offered, and colleges of priests instituted.

It was one of the doctrines of Pythagoras which he had borrowed from the Chaldees, that virtuous persons after their death were raised into the order of the gods.

And hence the ancients deified all the inventors of things useful to mankind; and those who had done any important service to the commonwealth.—Tiberius proposed to the Roman senate the apotheosis of Jesus Christ, as is related by Eusebius, Tertullian, and Chrysostom.

Juvenal rallying the frequent apotheoses, introduces poor Atlas, complaining that he was ready to sink under the burden of so many new gods as were every day added to the heavens. Seneca ridiculed the apotheosis of Claudius with admirable humour.

The ceremony, according to Herodian's description, was as follows: after the body of the deceased had been burnt with the usual solemnities, an image of wax, exactly resembling him, was placed on an ivory couch, where it lay for seven days, attended by the senate and ladies of the highest quality in mourning; and then the young senators and knights bore the bed of state through the via sacra to the old forum, and from thence to the campus martius, where it was deposited upon an edifice built in form of a pyramid. The bed being thus placed amidst a quantity of spices and other combustibles, and the knights having made a solemn procession round the pile, the new emperor, with a torch in his hand, set fire to it, whilst an eagle, let fly from the top of the building, and mounting in the air with a firebrand, was supposed to convey the soul of the deceased to heaven; and thenceforward he was ranked among the gods.

We often meet with the consecration or apotheosis of emperors represented on medals; where we see the pyramids of several stories, each growing less and less; we see also the eagles flying away with the souls of the deceased emperors. A gem in the musæam of Brandenburg, represents the apotheosis of Julius Cæsar, mounted upon the celestial globe, and holding an helm in his hand, as if he were now the governor of heaven, as before of the earth. See Deification.

APOTHERAPIA, (from αποθεραπευω, *I cure*), in physic, properly denotes a complete or finished cure.

Apotherapia is also used, in the gymnastic art, for the last part of all regular exercise, viz. friction or unction with oil, before as well as after bathing. The design of this was partly to cleanse the skin from any filth or dust it might have contracted during the exercise, and partly to remove weariness.

APOTOME, in geometry, the difference between two incomensurable lines.

Apotome, in music, the difference between a greater and lesser semi-tone; expressed by the ratio, 128 ; 125.

APOTROPÆA, (from αποτρεπω, *I avert*), in the ancient poetry, verses composed for averting the wrath of incensed deities; and the deities invoked for averting any threatened misfortune were called *Apotrepeans*: they were also called *Alexicaci*, from αλεξω, *I drive away*; and *Averrunci* from *averrunco*, which denotes the same.

APOZEM, in medicine, the same with decoction. See Decoction.

APPARATUS, a term used to denote a complete set of instruments, or other utensils, belonging to any artist or machine.

Apparatus is frequently used for the operation of cutting for the stone. For this there are three sorts of apparatus, viz. the small, great, and high apparatus. See Surgery.

Apparatus is also used as a title of several books composed in form of catalogues, bibliothecas, dictionaries, &c. for the ease and convenience of study. The apparatus to Cicero is a kind of concordance, or collection of Ciceronian phrases, &c. The apparatus sacer of Possevin, is a collection of all kinds of ecclesiastical authors printed in 1611, in three volumes.—Glossaries, comments, &c. are also frequently called *Apparatuses*.

APPARENT, in a general sense, something that is visible to the eyes, or obvious to the understanding.

Apparent, among mathematicians and astronomers, denotes things as they appear to us, in contradistinction from real or true; thus we say, the apparent diameter, distance, magnitude, place, figure, &c. of bodies.

Apparent Heir, in law. No inheritance can vest, nor can any person be the actual complete heir of another, till the ancestor is previously dead. *Nemo est hæres viventis*. Before that time the person who is next in the line of succession is called an *heir apparent*, or *heir presumptive*. Heirs *apparent* are such, whose right of inheritance is indefeasible, provided they outlive the ancestor; as the eldest son or his issue, who must by the course of the common law be heirs to the father whenever he happens to die. Heirs *presumptive* are such, who, if the ancestor should die immediately, would in the present circumstances of things be his heirs: but whose right of inheritance may be defeated by the contingency of some nearer heir being born; as a brother or nephew, whose presumptive succession may be destroyed by the birth of a child; or daughter, whose present hopes may be hereafter cut off by the birth of a son. Nay, even if the estate hath descended, by the death of the owner, to such a brother, or nephew, or daughter; in the former cases, the estate shall be divested and taken away by the birth of a posthumous child; and, in the latter, it shall be also totally divested by the birth of a posthumous son.

APPARITION, in a general sense, denotes simply the appearance of a thing. In a more limited sense, it is used for spectre or ghost.—Several instances of apparitions occur in the Bible; that of Samuel, raised by the witch of Endor, has occasioned great disputes. We find great controversies among authors, in relation to the reality, the existence or non-existence, the possibility or impossibility, of apparitions. The Chaldeans, the Jews, and other nations, have been the steady asserters of the belief of apparitions. The denial of spirits and apparitions is by some made one of the marks of infidelity, if not of atheism. Many of the apparitions we are told of in writers, are doubtless mere delusions of the sense; many others are fictitious, contrived merely to amuse, or answer some purpose. Apparitions, it is certain, are machines that on occasion have been of good service both to generals, to ministers of state, to priests and others.

Partial darkness, or obscurity, are the most powerful means by which the sight is deceived: night is therefore the proper season for apparitions. Indeed the state of the mind, at that time, prepares it for the admission of these delusions of the imagination. The fear and caution which must be observed in the night; the opportunity it affords for ambuscades and assassinations; depriving us of society, and cutting off many pleasing trains of ideas, which objects in the light never fail to introduce, are all circumstances of terror: and perhaps, on the whole, so much of our happiness depends upon our senses, that the deprivation of any one may be attended with proportionable horror and uneasiness. The notions entertained by the ancients respecting the soul, may receive some illustration from these principles. In dark or twilight, the imagination frequently transforms an inanimate body into a human figure; on approaching, the same appearance is not to be found: hence they sometimes fancied they saw their ancestors; but not finding the reality, distinguished these illusions by the name of *shades*.

Many of these fabulous narrations might originate from dreams. There are times of slumber when we are not sensible of being asleep. On this principle, Hobbes has ingeniously accounted for the spectre which is said to have appeared to Brutus. "We read," says he, "of M. Brutus, that at Philippi, the night before he gave battle to Augustus Cæsar, he saw a fearful apparition, which is commonly related by historians as a vision; but, considering the circumstances, one may easily judge it to have been but a short dream. For sitting in his tent, pensive and troubled with the horror of his rash act, it was not hard for him, slumbering in the cold, to dream of that which most affrighted him; which fear, as by degrees it made him wake, so it must needs make the apparition by degrees to vanish: and having no assurance that he slept, he could have no cause to think it a dream, or any thing but a vision."—The well-known story told by Clarendon, of the apparition of the Duke of Buckingham's father, will admit of a similar solution. There was no man in the kingdom so much the subject of conversation as the duke; and from the corruptness of his character, he was very likely to fall a sacrifice to the enthusiasm of the times. Sir George Villiers is said to have appeared to the man at midnight: therefore there is the greatest probability that the man was asleep; and the dream affrighting him, made a strong impression, and was likely to be repeated.

APPARITOR, among the Romans, a general term to comprehend all attendants of judges and magistrates appointed to receive and execute their orders. *Apparitor*, in England, is a messenger that serves the process of a spiritual court, or a beadle in an university who carries the mace.

APPAUMEE, in heraldry, denotes one hand extended, with the full palm appearing, and the thumb and fingers at full length.

APPEAL, in law, the removal of a cause from an inferior to a superior court, or judge, when a person thinks himself aggrieved by the sentence of the inferior judge. Appeals lie from all the ordinary courts of justice to the House of Lords. In ecclesiastical cases, if an appeal is brought before a bishop, it may be removed to the archbishop; if before an archdeacon, to the court of arches, and thence to the archbishop; and from the archbishop's court to the king in chancery.

Appeal, in common law, denotes an accusation by a private subject against another, for some heinous crime; demanding punishment on account of the particular injury suffered, rather than for the offence against the public.

This private process, for the punishment of public crimes, had probably its original in those times, when a private pecuniary satisfaction, called a *weregild*, was

Appeal. constantly paid to the party injured, or his relations, to expiate enormous offences. This was a custom derived to the English, in common with other northern nations, from their ancestors the ancient Germans; among whom, according to Tacitus, *luitur homicidium certo armentorum ac pecorum numero; recipitque satisfactionem universa domus*. In the same manner, by the Irish Brehon law, in case of murder, the brehon or judge was used to compound between the murderer and the friends of the deceased who prosecuted him, by causing the malefactor to give unto them, or to the child or wife of him that was slain, a recompence which they called an *eriach*. And this we find in the Anglo-Saxon laws (particularly those of king Athelstan) the several weregilds for homicide established in progressive order, from the death of the ceorl or peasant, up to that of the king himself. And in the laws of Henry I. we have an account of what other offences were redeemable by weregild, and what were not so. As therefore, during the continuance of this custom, a process was certainly given, for recovering the weregild by the party to whom it was due; it seems that, when these offences by degrees grew no longer redeemable, the private process was still continued, in order to insure the infliction of punishment upon the offender, though the party injured was allowed no pecuniary compensation for the offence.

But though appeals were thus, in the nature of prosecutions for some attrocious injury, committed more immediately against an individual, yet it also was anciently permitted, that any subject might appeal another subject of high-treason, either in the courts of common law, or in parliament, or (for treasons committed beyond the seas) in the court of the high constable and marshal. The cognizance of appeals in the latter still continues in force; and so late as 1631, there was a trial by battle awarded in the court of chivalry, on such an appeal of treason; but that in the first was *virtually* abolished by the statutes 5 Edw. III. c. 9. and 2 Edw. III. c. 24. and in the second *expressly* by statute 1 Hen. IV. c. 14. So that the only appeals now in force, for things done within the realm, are appeals of felony and mayhem.

An appeal of felony may be brought for crimes committed either against the parties themselves or their relations. The crimes against the parties themselves are *larceny*, *rape*, and *arson*. And for these, as well as for mayhem, the persons robbed, ravished, maimed, or whose houses are burnt, may institute this private process. The only crime against one's relation, for which an appeal can be brought, is that of *killing* him, by either murder or manslaughter. But this cannot be brought by every relation; but only by the wife for the death of her husband, or by the heir-male for the death of his ancestor; which heirship was also confined by an ordinance of Henry I. to the four nearest degrees of blood. It is given to the wife, on account of the loss of her husband: therefore, if she marries again, before or pending her appeal, it is lost and gone; or, if she marries after judgment, she shall not demand execution. The heir, as was said, must also be heir-male, and such a one as was the next heir by the course of the common law at the time of the killing of the ancestor. But this rule has three exceptions: 1. If the person killed leaves an innocent wife, she only, and not the heir, shall have the appeal: 2. If there be no wife, and the heir be accused of the murder, the person, who next to him would have been heir-male, shall bring the appeal: 3. If the wife kills her husband, the heir may appeal her of the death. And, by the statute of Gloucester, 6 Ed. I. c. 9. all appeals of death must be sued within a year and a day after the completion of the felony by the death of the party: which seems to be only declaratory of the old common law; for in the Gothic constitutions we find the same "*prescriptio annalis, quæ currit adversus actorem, si de homicida ei non constat intra annum a cæde facta, nec quenquam interea arguat et accuset.*"

These appeals may be brought previous to any indictment; and, if the appellee be acquitted thereon, he cannot be afterwards indicted for the same offence. In like manner as by the old Gothic constitution, if any offender gained a verdict in his favour, when prosecuted by the party injured, he was also understood to be acquitted of any crown-prosecution for the same offence: but, on the contrary, if he made his peace with the king, still he might be prosecuted at the suit of the party. And so, in England, if a man be acquitted on an indictment of murder, or found guilty, and pardoned by the king, still he ought not (in strictness) to go at large, but be imprisoned or let to bail till the year and day be past, by virtue of the statute 3 Hen. VIII. c. 1. in order to be forthcoming to answer any appeal for the same felony, not having as yet been punished for it: though, if he hath been found guilty of manslaughter on an indictment, and hath had the benefit of clergy, and suffered the judgment of the law, he cannot afterwards be appealed; for it is a maxim in law, "that *nemo bis punitur pro eodem delicto*." Before this statute was made, it was not usual to indict a man for homicide within the time limited for appeals, which produced very great inconvenience.

If the appellee be acquitted, the appellor (by virtue of the statute of Westm. 2. 13 Edw. I. c. 12.) shall suffer one year's imprisonment, and pay a fine to the king, besides restitution of damages to the party for the imprisonment and infamy which he has sustained: and, if the appellor be incapable to make restitution, his abettors shall do it for him, and also be liable to imprisonment. This provision, as was foreseen by the author of Fleta, proved a great discouragement to appeals; so that thenceforward they ceased to be in common use.

If the apellee be found guilty, he shall suffer the same judgment, as if he had been convicted by indictment: but with this remarkable difference, than on an indicment, which is at the suit of the king, the king may pardon and remit the execution; on an appeal, which is at the suit of a private subject, to make an atonement for the private wrong, the king can no more pardon it, than he can remit the damages recovered on an action of battery. In like manner as, while the weregild continued to be paid as a fine for homicide, it could not be remitted by the king's authority. And the ancient usage was, so late as Henry IV.'s time, that all the relations of the slain should drag the appellee to the place of execution: a custom, founded upon that savage spirit of family-resentment which prevailed universally through Europe after the irruption of the northern nations, and is peculiarly attended to in their several codes of law; and which prevails even now among the

the wild and untutored inhabitants of America: as if the finger of nature had pointed it out to mankind, in their rude and uncultivated state. However, the punishment of the offender may be remitted and discharged by the concurrence of all parties interested; and as the king by his pardon may frustrate an indictment, so the appellant by his release may discharge an appeal: "*nam quilibet potest renunciare juri pro se introducto.*"

APPEARANCE, in a general sense, the exterior surface of a thing, or that which immediately strikes the senses.

APPEARANCE, in law, signifies a defendant's filing a common or special bail, on any process issued out of a court of judicature.

APPELLANT, in a general sense, one who appeals. See APPEAL.

APPELLANTS, in church history, an appellation given to such of the catholic clergy as appeal from the constitution unigenitus to a general council.

APPELLATION, the name by which any thing is known or distinguished when spoken of. See NAME.

Nothing can be more foreign to the original meaning of many words and proper names, than their present appellations, frequently owing to the history of those things being forgotten, or an ignorance of the language in which they were expressed. Who, for example, when the crier of a court bawls out, "O yes, O yes," would dream that it was a proclamation commanding the talkers to become hearers, being the French word *Oyez*, "listen," retained in our courts ever since the pleadings were held in law French? Or would any person suppose that the head-land on the French coast, near Calais, called by our seamen Blackness, could be so titled from its French name of *Blanc Nez*, or, the *White Head-land*?

King Henry the Eighth having taken the town of Bullogne in France, the gates of which he brought to Hardes in Kent, where they are still remaining, the flatterers of that reign highly magnified this action, which, Porto Bello like, became a popular subject for signs; and the port or harbour of Bullogne, called *Bullogne mouth*, was accordingly set up at a noted inn in Holburn; the name of the inn long out-living the sign and fame of the conquest, an ignorant painter employed by a no less ignorant landlord, to paint a new one, represented it by a bull and a large gaping human mouth (answering to the vulgar pronunciation of *Bull and mouth*). The same piece of history gave being to the *bull and gate*, originally meant for Bullogne gate, and represented by an embattled gate or entrance into a fortified town.

The *barber's pole* has been the subject of many conjectures; some conceiving it to have originated from the world *poll*, or head, with several other conceits as far-fetched and as unmeaning: but the true intention of that party-coloured staff was to show that the master of the shop practised surgery, and could breathe a vein as well as mow a beard; such a staff being to this day, by every village-practitioner, put into the hand of a patient undergoing the operation of phlebotomy. The white band which encompasses the staff, was meant to represent the fillet, thus elegantly twined about it.

Nor were the *Chequers* (at this time a common sign of a public-house) less expressive, being the representation of a kind of draught-board called *tables*, and showed that there that game might be played. From their colour which was red, and the similiarity to a lattice, it was corruptly called the *red lettuce*, which word is frequently used by ancient writers to signify an alehouse.

The Spectator has explained the sign of the *bell savage inn* plausibly enough, in supposing it to have been originally the figure of a beautiful female found in the woods, called in French *la belle sauvage*. But another reason has since been assigned for that appellation, namely, that the inn was once the property of Lady Arabelle savage, and familiarly called Bell Savage's inn, probably represented, as at present, by a bell and a savage or wild man, which was a rebus for her name; rebusses being much in fashion in the 16th century, of which the bolt and tun is an instance.

The *three blue balls* prefixed to the doors and windows of pawn-brokers shops, by the vulgar humorously enough said to indicate that it is two to one that the things pledged are ever redeemed, was in reality the arms of a set of merchants from Lombardy, who were the first that publicly lent money on pledges. They dwelt together in a street, from them named Lombard-street, in London, and also gave their name to another at Paris. The appellation of Lombard was formerly all over Europe considered as synonimous to that of usurer.

At the institution of yeomen of the guards, they used to wait at table on all great solemnities, and were ranged near the buffets; this procured them the name of *buffetiers*, not very unlike in sound to the jocular appellation of *beef-eaters*, now given them; though probably it was rather the voluntary misnomer of some wicked wit, than an accidental corruption arising from ignorance of the French language.

The opprobious title of *bum-bayliffe*, so constantly bestowed on the sheriffs officers, is, according to Judge Blackstone, only the corruption of *bound bayliffe*, every sheriff's officer being obliged to enter into bonds and to give security for his good behaviour, previous to his appointment.

A *cordwainer* seems to have no relation to the occugation it is meant to express, which is that of a shoemaker. But *cordonier*, originally spelt *cordaunier*, is the French word for that trade; the best leather used for shoes coming originally from Cordua in Spain. Spanish-leather shoes were once famous in England.

APPELLATIVE NAMES, in grammar, in contradistinction to proper names, are such as stand for universal ideas, or a whole rank of beings, whether general or special. Thus fish, bird, man, city, river, are common or appellative names; and so are trout, eel, lobster; for they all agree to many individuals, and some to many species. See NAME.

APPELLEE, among lawyers, the person against whom an appeal is brought. See APPEAL.

APPENDIX, in literature, a treatise or supplement added at the end of a work, to render it more complete.

APPERCEPTION, or ADPERCEPTION, a term used by Leibnitz and his followers for consciousness.

APPETITE, in a general sense, the desire of enjoying some object, supposed to be conducive to our happiness. When this inclination is guided by reason, and proportioned to the intrinsic value of the object, it is called *rational appetite*; as, on the other hand, it is denominated

denominated *sensitive appetite*, when we have only a blind propensity to a thing, without determinate ideas of the good qualities for which we desire it.

Appetites are passions directed to general objects, in contradistinction to passions directed to particular objects, which retain their proper name. Thus we say, an *appetite* for fame, for glory, for conquest, for riches; but we say the *passion* of love, of gratitude, of envy, &c. Appetite may be also distinguished from passion, since the latter has no existence till a proper object be presented; whereas the former exists first, and then is directed to an object.

Appetite, in medicine, a certain painful or uneasy sensation, always accompanied with a desire to eat or drink.—An excessive appetite is called by physicians *bulimy* or *fames canina*; a defect or loss of it, *anorexy*; and that after things improper for food, *pica*.

APPIA via, a way reaching from Rome through Capua to Brundusium, between 330 and 350 miles long. Appius Claudius, surnamed *Cæcus*, in the year of the city 441, carried it from the Porta Capena to Capua (Livy, Frontinus). It was afterwards carried on to Brundusium; but by whom, or when, is uncertain. It was laid with very hard stone, brought from a great distance, large and squared (Diodorus); and it was so wide, that several waggons could go abreast. Statius calls it *the queen of roads*. Its course is described by Horace, Strabo, and Antonine.

APPIAN, an eminent writer of the Roman history in Greek, under the reign of Trajan and Hadrian. He was of a good family in Alexandria in Egypt; whence he went to Rome, and there distinguished himself so well as an advocate, that he was chosen one of the procurators of the empire, and the government of a province was committed to him. He did not complete the Roman history in a continued series; but wrote distinct histories of all nations that had been conquered by the Romans, in which he placed every thing relating to those nations in the proper order of time. His style is plain and simple: in the opinion of Phocius, he has shown the greatest knowledge of military affairs, and the happiest talent at describing them, of any of the historians; for while we read him, we in a manner see the battles which he describes. Of all this voluminous work there remains only what treats of the Punic, Syrian, Parthian, Mithridatic, and Spanish wars, with those against Hannibal, the civil wars, and the wars in Illyricum, and some fragments of the Celtic or Gallic wars.

APPIUS Claudius, a Sabine by birth, one of the principal inhabitants of Regillum: his shining merit having drawn the envy of his fellow-citizens upon him, he retired to Rome with all his family. Appius was admitted into the senate, and was made consul, with Publius Servilius Priscus, in 258 from the building of Rome: but he was hated by the Plebeians, being an austere opposer of their clamours and seditions. The Claudian family continued long one of the most illustrious of the patrician families in Rome; and several in succession of the name of Appius supported the same stern character that distinguished their first founder.

APPLAUSE, an approbation of something, signified by clapping the hands, still practised in theatres.—Applause, in antiquity, differed from ACCLAMATION, as the latter was articulate and performed with the voice, the former with the hands. Among the Romans, applause was an artificial musical kind of noise, made by the audience or spectators to express their satisfaction. There were three species of applause, denominated from the different noises made in them, viz. *Bombus*, *Imbrices*, and *Testæ*; the first a confused din, made either by the hands or the mouth; the second and third, by beating on a sort of sounding vessels placed in the theatres for this purpose. Persons were instructed to give applause with skill; and there were even masters who professed to teach the art. The proficients in this way let themselves out for hire to the vain-glorious among the poets, actors, &c. and were properly disposed to support a loud applause. These they called *Laudicæni*, and Σοφοκλεις. At the end of the play, a loud peal of applause was expected, and even asked of the audience, either by the chorus or the person who spoke last. The formula was, *Spectatores plaudite*, or *Valete et plaudite*. The *plausores*, or applauders, were divided into chori, and disposed in theatres opposite to each other like the choristers in cathedrals, so that there was a kind of concert of applauses.

APPLE, the fruit of the pyrus malus. See Pyrus.

Apple of the eye, a name not unfrequently given to the pupil. See Anatomy.

Apples of Love. See Lycopersicon.

Mad Apples. See Melongena.

APPLEBY, the county-town of Westmoreland, where the assizes are held, is seated on the banks of the river Eden, which almost surrounds it. It was formerly a very considerable town, and had great privileges; but it is long ago gone to decay, and now only consists of mean houses in one broad street, which runs with an easy ascent from north to south; at the head of which is the castle, almost entirely surrounded by the river. It has two churches; a town hall, in which the assizes are held: a county jail; and an hospital for a governess and twelve widows, founded in 1651 by a daughter of lord Clifford. It is governed by a mayor, twelve aldermen, a common council, and two sergeants at mace, &c. Here is said to be the best corn-market in these northern parts. It sends two members to parliament. W. Long. 3. 52. N. Lat. 54. 30.

APPLICATION, in a general sense, is the laying two things together, in order to discover their agreement or disagreement.

Application, in geometry, is used either for division, for applying one quantity to another, whose areas, but not figures, shall be the same; or, for transferring a given line into a circle, or other figure, so that its ends shall be in the perimeter of the figure.

Application, in theology, is particularly used, by some divines, for the act whereby our Saviour transfers, or makes over to us, what he had earned or purchased by his holy life and death. Accordingly it is by this application of the merits of Christ that we are to be justified, and entitled to grace and glory. The sacraments are the ordinary means or instruments whereby this application is effected.

APPOGIATURA, in music, a small note inserted by the practical musician, between two others, at some distance.

APPOINTEE, a foot-soldier in the French army, &c. who for his long service and bravery receives pay above private sentinels. These have been suppressed in France,

France, except in the regiment of French guards, where forty appointees are ſtill retained to each company of 150 men.

Till the year 1670, they had alſo captains and lieutenants under the appellation of *appointees*, who, without reſiding in the regiment, received their pay.

APPOINTEE, in heraldry, the ſame as *aguiſée:* Thus we ſay, a croſs appointée, to ſignify that with two angels at the end cut off, ſo as to terminate in points.

APPOINTMENT, in a general ſenſe, the ſame as ASSIGNATION.

APPOINTMENT, in a particular ſenſe, denotes a penſion or ſalary given by great lords and princes to perſons of worth and parts, in order to retain them in their ſervice. The term is chiefly uſed among the French. The king of France gives large appointments to ſeveral of the officers in his ſervice. Appointments differ from wages, in that the latter are fixed and ordinary, being paid by the ordinary treaſurers; whereas appointments are annual gratifications granted by *brevet* for a time uncertain, and are paid out of the privy purſe.

APPOSER ſignifies an examiner. In the court of exchequer, there is an officer called the *foreign appoſer*. In the office of confirmation, in the firſt liturgy of Edward VI. the rubric directs the biſhop, or ſuch as he ſhall appoint, to appoſe a child; and a biſhop's examining chaplain was anciently called his *poſer*.

APPOSITION, in grammar, the placing two or more ſubſtantives together in the ſame caſe, without any copulative conjunction between them; as, *Ardebat Alexim, delicias domini.*

APPRAISER (from *ad*, "to," and *pretium*, "value") one who rates or ſets a value upon gooods, &c. He muſt be a ſkilful and honeſt perſon. It is not a buſineſs of itſelf, but is practiſed by brokers of houſehold-furniture; to which ſet of men the word is chiefly applied: Yet upholſterers and other brokers are employed, or even any perſon or perſons who are ſuppoſed to be ſkilled in the commodities to be appraiſed or valued. They are employed in caſes of death, executions brought in upon goods, or of ſtock to be turned over from one perſon to another, or divided between copartners; and are called *ſworn appraiſers*, from their taking an oath to do juſtice between party and party. They ſometimes appraiſe on behalf of both ſides, each party agreeing to have the ſame appraiſer or appraiſers; ſometimes in oppoſition, each party chooſing one or more of a ſide; and ſometimes by commiſſion or deputation of truſtees, maſters in chancery, &c.

APPRAISING, the act of rating, valuing, or ſetting a price on goods, by a perſon who is a competent judge, and is authoriſed thereto. See APPRAISER.

APPREHENSION, in logic, denotes the ſimple attention of the mind to an object preſented either to our ſenſe or our imagination, without paſſing a judgement or making any inference.

APPREHENSION is likewiſe uſed to expreſs an inadequate and imperfect idea: and thus it is applied to our knowledge of God, in contradiſtinction to comprehenſion.

APPREHENSION, in law, ſignifies the ſeizing a criminal, in order to bring him to juſtice.

APPRENTICE, (from *apprendre*, "to learn,") one who is bound by covenant to ſerve a tradeſman or artificer a certain time, upon condition of the maſter's inſtructing him in his art or myſtery.

Apprentices may likewiſe be bound to huſbandmen, or even to gentlemen; and they, as well as tradeſmen, in England, are compellable to take the children of the poor, whom the overſeers, with the conſent of two juſtices, may bind till the age of twenty-four years. Apprentices may be diſcharged on reaſonable cauſe; but if any, whoſe premium has been leſs than ten pounds, run away from their maſters, they are compellable to ſerve out the time of abſence, or give ſatisfaction for it, at any period within ſeven years after expiration of the original contract. Apprentices gain a ſettlement in that pariſh where they laſt ſerved forty days; and by the 5th of Elizabeth, c. 4. they have an excluſive right to exerciſe the trade in which they have been inſtructed, in any part of England. However, the reſolutions of the courts have in general rather confined than extended the reſtriction of this ſtatute. See Blackſtone's Com. Vol. I. p. 426, &c.

In France, the ſons of tradeſmen, living in their father's houſe till ſeventeen years of age, are reputed to have ſerved an apprenticeſhip. In that country, the times of ſerving are different in the differet profeſſions, from three years to eight. After ſerving out an apprenticeſhip, the perſon becomes what they call an *aſpirant*, or candidate for maſterſhip, and is to be examined by proper officers as to his ſkill and proficiency, and alſo to exhibit a *chef d'oeuvre* or maſterpiece in the art he has been bred to, before he be ſuffered to ſet up to practiſe for himſelf. And the cuſtom of France in regard to apprentices, is not unworthy the imitation of other nations.

Anciently, benchers in the inns of court were called *apprentices of the law*, in Latin *apprenticii juris nobiliores;* as appears by Mr Selden's note on Forteſcue: and ſo the learned Plowden ſtyles himſelf. Sir Henry Finch, in in his *Nomotechnia*, writes himſelf, *apprentice de ley:* Sir Edward Coke in his *Inſt.* ſays, *Apprenticii legis*, in pleading, are called *homines conſiliarii et in lege periti;* and in another place, *apprentices* and other counſellors of law.

Apprentices indentures and articles of clerkſhip, pay of duty ſix ſhillings. Pariſh indentures are excepted, and pay ſixpence only, by 5 W. 3. c. 21. For fees given with apprentices, clerks, or ſervants, bound or articled by indentures, from 1 l. to 50 l. maſters pay for every pound ſixpence; and for fees above 50 l. one ſhilling in the pound. 8 Ann. c. 9.

APPRENTICESHIP, the ſervitude of an apprentice, or the duration of his indenture.

Seven years ſeem anciently to have been, all over Europe, the uſual term eſtabliſhed for the duration of apprenticeſhips in the greater part of incorporated trades. All ſuch incorporations were anciently called *univerſities;* which, indeed, is the proper Latin name for any incorporation whatever. The univerſity of ſmiths, the univerſity of taylors, &c. are expreſſions which we commonly meet with in the old charters of ancient towns. When thoſe particular incorporations which are now peculiarly called *univerſities* were firſt eſtabliſhed, the term of years which it was neceſſary to ſtudy, in order to obtain the degree of maſter of arts, appears evidently to have been copied from the term of apprenticeſhip in common trades, of which the incorporations

Apprenticeship. porations were much more ancient. As to have wrought ſeven years under a maſter properly qualified was neceſſary in order to intitle any perſon to become a maſter, and to have himſelf apprentices in a common trade; ſo to have ſtudied ſeven years under a maſter properly qualified was neceſſary to intitle him to become a maſter, teacher, or doctor (words anciently ſynonimous), in the liberal arts, and to have ſcholars or apprentices (words likewiſe originally ſynonimous) to ſtudy under him.

By the 5th of Elizabeth, commonly called the *ſtatute of apprenticeſhip*, it was enacted, that no perſon ſhould for the future exerciſe any trade, craft or myſtery, at that time exerciſed in England, unleſs he had previouſly ſerved to it an apprenticeſhip of ſeven years at leaſt; and what before had been the bye-law of many particular corporations, became in England the general and public law of all trades carried on in market-towns. For though the words of the ſtatute are very general, and ſeem plainly to include the whole kingdom, by interpretation its operation has been limited to market-towns; it having been held, that in country villages a perſon may exerciſe ſeveral different trades, though he has not ſerved a ſeven years apprenticeſhip to each, they being neceſſary for the conveniency of the inhabitants, and the number of people frequently not being ſufficient to ſupply each with a particular ſet of hands.

By a ſtrict interpretation of the words, too, the operation of this ſtatute has been limited to thoſe trades which were eſtabliſhed in England before the 5th of Elizabeth, and has never been extended to ſuch as have been introduced ſince that time. This limitation has given occaſion to ſeveral diſtinctions which, conſidered as rules of police, appear as fooliſh as can well be imagined. It has been adjudged, for example, that a coachmaker can neither himſelf make, nor employ journeymen to make, his coach-wheels, but muſt buy them of a maſter wheel-wright; this latter trade having been exerciſed in England before the 5th of Elizabeth. But a wheelwright, though he has never ſerved an apprenticeſhip to a coachmaker, may either himſelf make, or employ journeymen to make, coaches; the trade of a coachmaker not being within the ſtatute, becauſe not exerciſed in England at the time when it was made. The manufactures of Mancheſter, Birmingham, and Wolverhampton, are many of them upon this account not within the ſtatute; not having been exerciſed in England before the fifth of Elizabeth.

In France, the duration of apprenticeſhips is different in different towns and in different trades. In Paris, five years is the term required in a great number; but before any perſon can be qualified to exerciſe the trade as a maſter, he muſt in many of them, ſerve five years more as a journeyman. During this latter term he is called the *companion* of his maſter, and the term itſelf is called his *companionſhip*.

In Scotland there is no general law which regulates univerſally the duration of apprenticeſhips. The term is different in different corporations. Where it is long, a part of it may generally be redeemed by paying a ſmall fine. In moſt towns, too, a very ſmall fine is ſufficient to purchaſe the freedom of any corporation. The weavers of linen and hempen cloth, the principal manufactures of the country, as well as all other artificers ſubſervient to them, wheelmakers, reelmakers, &c. may exerciſe their trades in any town corporate, without paying any fine. In all towns corporate, all perſons are free to ſell butcher's meat upon any lawful day of the week. Three years is in Scotland a common term of apprenticeſhip, even in ſome very nice trades; and in general there is no country in Europe in which corporation laws are ſo little oppreſſive.

Apprenticeſhip, Appriſing.

Apprenticeſhips were altogether unknown to the ancients. The reciprocal duties of maſter and apprentice make a conſiderable article in every modern code. The Roman law is perfectly ſilent with regard to them. There is no Greek or Latin word which expreſſes the idea we now annex to the word apprentice; a ſervant bound to work at a particular trade for the benefit of a maſter during a term of years, upon condition that the maſter ſhall teach him that trade.

Long apprenticeſhips Dr Smith conſiders as altogether unneceſſary. The arts, which are much ſuperior to common trades, ſuch as thoſe of making clocks and watches, contain no ſuch myſtery as to require a long courſe of inſtruction. The firſt invention of ſuch beautiful machines, indeed, and even that of ſome of the inſtruments employed in making them, muſt, no doubt, have been the work of deep thought and long time, and may juſtly be conſidered as among the happieſt efforts of human ingenuity: But when both have been fairly invented and are well underſtood; to explain to any young man, in the compleateſt manner, how to apply the inſtruments and how to conſtruct the machines, cannot well require more than the leſſons of a few weeks; perhaps thoſe of a few days might be ſufficient. In the common mechanic trades, thoſe of a few days might certainly be ſufficient. The dexterity of hand, indeed, even in common trades cannot be acquired without much practice and experience. But a young man would practiſe with much more diligence and attention, if from the beginning he wrought as a journeyman, being paid in proportion to the little work which he could execute, and paying in his turn for the materials which he might ſometimes ſpoil though aukwardneſs and inexperience. His education in this way generally would be more effectual, and always leſs tedious and expenſive. The maſter, indeed, would be a loſer; he would loſe all the wages of the apprentice, which he now ſaves, for ſeven years together. In the end, perhaps, the apprentice himſelf would be a loſer. In a trade ſo eaſily learnt he would have more competitors: and his wages, when he came to be a complete workman, would be much leſs than at preſent. The ſame increaſe of competition would reduce the profits of the maſters as well as the wages of the workmen. The trades, the crafts, the myſteries, would be all loſers: but the public would be a gainer; the work of all artificers coming in this way much cheaper to market.

Wealth of Nations, Vol. i. p. 162 Philad. Edition.

APPRISING, in Scots law, the name of that action by which a creditor formerly carried off the eſtate of his debtor for payment. It is now aboliſhed, and adjudications are appointed in place of it.—Adjudications, charter, reſignation, clare conſtat, cognition of heirs, heritable right, confirmation, novodamus, principal and original inſtrument of ſurrender, retour, ſeiſin, and ſervice, in Scotland, pay by different acts 4s. 9d. duty.

APPROACH, or APPROACHING, in a general sense, the acceding or coming together of two or more things.

APPROACHES, in fortification, the works thrown up by the besiegers, in order to get nearer a fortress, without being exposed to the enemy's cannon.

APPROACHING, in fowling, a term used to express such devices as are contrived for the getting within shot of shy birds. It is principally used in marshy low places. The best method of approaching is by means of three hoops tied together at proper distances, according to the height of the man that is to use it, and having boughs of trees tied all round it, with cords to hang it over his shoulders; a man getting into this, conceals himself, and approaches by degrees towards his game in the form of a moving bush. Geese, ducks, and teal, quit the waters in the evening, and pass the night in the fields; but at the approach of morning they return to the water again, and even when on the water they will retire to great distances, on the approach even of a horse or cow, so that the business of the stalking-horse is of little use; but this device of approaching by the moving bush succeeds tolerably well with them.

APROACHING, in gardening, the inoculating or ingrafting the sprig of one tree into another, without cutting it off the parent tree.

APPROBATION, a state or disposition of the mind, wherein we put a value upon, or become pleased with, some person or thing. Moralists are divided on the principle of approbation or the motive which determines us to approve and disapprove. The Epicureans will have it to be only self-interest: according to them, that which determines any agent to approve his own action, is its apparent tendency to his private happiness; and even the approbation of another's action flows from no other cause but an opinion of its tendency to the happiness of the approver, either immediately or remotely. Others resolve approbation into a moral sense, or a principle of benevolence by which we are determined to approve every kind affection either in ourselves or others, and all publicly useful actions, which we imagine to flow from such affection, without any view therein to our own private happiness.

APPROBATION, is more particularly used, in speaking of recommendations of books, given by persons qualified or authorised to judge of them. Those appointed to grant licences and imprimatures, frequently express their approbations of books. Books were formerly subjected to a licenser in England (see 13th Car. II. c. 33), which act is long since expired; and being incompatible with the noble principles of the Revolution, has never since been, and it is hoped never will be, revived.

APPROPRIATION, in the canon law, a severing of a benefice ecclesiastical to the proper and perpetual use of some religious house. See the article PARSON.

The contrivance of appropriations seems to have sprung from the policy of the monastic orders, who have never been deficient in subtile inventions for the increase of their own power and emoluments. At the first establishment of parochial clergy, the tithes of the parish were distributed in a fourfold division; one for the use of the bishop, another for maintaining the fabric of the church, a third for the poor, and the fourth to provide for the incumbent. When the fees of the bishops became otherwise amply endowed, they were prohibited from demanding their usual share of these tithes, and the division was into three parts only. And hence it was inferred by the monasteries, that a small part was sufficient for the officiating priest; and that the remainder might well be applied to the use of their own fraternities (the endowment of which was construed to be a work of the most exalted piety), subject to the burden of repairing the church and providing for its constant supply. And therefore they begged and bought, for masses and obits, and sometimes even for money, all the advowsons within their reach, and then appropriated the benefices to the use of their own corporation. But, in order to complete such approbriation effectually, the king's licence, and consent of the bishop, must first be obtained; because both the king and the bishop may some time or other have an interest by lapse, in the presentation to the benefice; which can never happen if it be appropriated to the use of a corporation, which never dies: and also because the law reposes a confidence in them, that they will not consent to any thing that shall be to the prejudice of the church. The consent of the patron also is necessarily implied, because the appropriation can be originally made to none but to such spiritual corporation as is also the patron of the church; the whole being indeed nothing else but an allowance for the patrons to retain the tithes and glebe in their own hands, without presenting any clerk, they themselves undertaking to provide for the service of the church. When the appropriation is thus made, the appropriators and their successors are perpetual parions of the church; and must sue and be sued, in all matters concerning the rights of the church, by the name of *parsons*.

This appropriation may be severed, and the church become disappropriate, two ways; as, first, if the patron or appropriator presents a clerk, who is instituted and inducted to the parsonage: for the incumbent so instituted and inducted is to all intents and purposes complete parson; and the appropriation being once severed, can never be reunited again, unless by a repetition of the same solemnities. And, when the clerk so presented is distinct from the vicar, the rectory thus vested in him becomes what is called a *sine-cure;* because he hath no cure of souls, having a vicar under him to whom that cure is committed. Also, if the corporation which has the appropriation is dissolved, the parsonage becomes disappropriate at common law: because the perpetuity of person is gone, which is necessary to support the appropriation.

In this manner, and subject to these conditions, may appropriations be made at this day: and thus were most if not all of the appropriations at present existing originally made; being annexed to bishopricks, prebends, religious houses, nay, even to nunneries, and certain military orders, all of which were spiritual corporations. At the dissolution of monasteries, by statutes 27 Hen. VIII. c. 28. and 31 Hen. VIII. c. 13. the appropriations of several parsonages, which belonged to those respective religious houses, (amounting to more than one third of all the parishes of England), would have been by the rules of common law disappropriated; had not a clause in those statutes intervened, to give them to the king in as ample a manner as the abbots, &c. formerly held the same at the time of their dissolution. This, though perhaps scarcely defensible, was not without example: for the same was done in former reigns, when the alien priores (that is, such as were filled by foreigners only) were dissolved and given to the crown. And from these two roots have sprung all the lay-appropriations or secular parsonages which we now see in the kingdom; they having been afterwards granted out from time to time by the crown. See the article *Parson and Vicar*.

APPROVER, in law, one who, confessing felony in himself, appealeth or impeacheth another or more of his accomplices. He is so called from the French *approuver, comprobare*, because he must prove what he hath alleged in his appeal. This proof was anciently either by battle, or by the country, at the choice of the appellee: and the form of this accusation may be found in Crompt. Just. 250.

Approvers of the king, are those who have the letting of the king's demesnes in small manors, &c. In the statute of the 1st of Ed. 3. c. 8. sheriffs are called the king's *approvers*.

It being in the discretion of the court to suffer one to be an approver, this method of late hath seldom been practised. But we have in cases of burglary and robbery on the highway, what seems to amount to the same by statute; it being ordained, that where persons charged with such crimes out of prison, discover two others concerned in the crime, they shall have a pardon, &c. Stat. 5th Anne, c. 31.

Approver is particularly used in ancient law writers, for a baliff or land-steward, appointed to have the care of a manor, franchise, or the like, and improve and make the most of it for the benefit of his master. In this sense, the word is also written *appruare*.

APPROXIMATION, in arithmetic and algebra, the coming nearer and nearer to a root, or other quantity sought, without expecting to be ever able to find it exactly.

APPUI, in the manege, (*q. d.* rest or stay upon the hand), is the reciprocal effort between the horse's mouth and the bridle-hand, or the sense of the action of the bridle on the hand of the horseman.

A just appui of the hand, is the nice bearing up or stay of the bridle, so that the horse, being awed by the sensibility and tenderness of his mouth, dares not rest too much upon the bit-mouth, nor check or beat upon the hand to withstand it. A horse is said to have no appui, when he is too apprehensive of the hand, and cannot bear the bit. He is said to have too much appui, when he rests or throws himself too much upon the bit. Horses designed for the army ought to have a full appui upon the hand. To give a horse a good appui, he should be galloped, and put often back.

APPULSE, in astronomy, the approach of any planet to a conjunction with the sun, or a star. It is a step towards a transit, occultation, conjunction, eclipse, &c. M. Flamsted, M. de la Hire, and others, have given observations of the moon's appulses to the pleiades. *Phils. Trans.* N° 76. p. 361. *M. Acad. Science. an.* 1708.

APRICOT, in botany. See Prunus.

APRIES, son of Psammis, king of Egypt; the same with Pharaoh Hophrah in Jeremiah and Ezekiel. He ruined Sidon, and some say he put Jeremiah to death. He thought neither God nor man could dethrone him; which yet was easily done by Amasis, and he himself was strangled by the Egyptians.

APRIL, the fourth month of the year, according to the common computation, but the second, according to that of the astronomers. It contains 30 days.—The word is derived from *aprilis*, of *aperio*, "I open;" because the earth, in this month, begins to open her bosom for the production of vegetables. In this month the sun travels through the sign Taurus.

A PRIORI, a kind of demonstration. See Demonstration.

APRON, in naval architecture, is a piece of curved timber fixed behind the lower part of the stern, immediately above the foremost end of the keel.

Apron is also a name given to a platform or flooring of plank, raised at the entrance of a dock, against which the dock-gates are shut.

Apron, in gunnery, a piece of lead which caps or covers the vent or touch-hole of a great gun.

APSIS or absis, signifies the bowed or arched roof of a house, room, or oven, &c. as also the ring or compass of a wheel.

Apsis in ecclesiastical writers, denotes an inner part in the ancient churches, wherein the clergy sat, and where the altar was placed. It is supposed to have been thus called, because covered with an arch or vault of its own, by the Greeks called αψις, by the Latins *absis*. Apsis, in this sense, amounts to the same with what is otherwise called *choir, concha, camera*, and *presbyterium*; and stands opposite to the *nave* or body of the church.

Apsis is more particularly used for the bishop's seat, or throne, in ancient churches. This was peculiarly called *apsis gradata*, because raised on steps above the ordinary stalls.—It was also denominated *exedra*, and in latter times *tribune*.

Apsis is also used for a reliquary, or case, wherein the relics of saints were anciently kept. It took the name *apsis*, from its being round, or arched at the top; or perhaps from the place where it was kept. The *apsis* was commonly placed on the altar: it was usually of wood, sometimes also of gold and silver, with sculptures, &c.

Apsis, in astronomy, a term used indifferently for either of the two points of a planet's orbit, where it is at greatest or least distance from the sun or earth; and hence the line connecting those points is called the line of the *apsides*. The word is Greek, and derived from απτω, to *connect*. The apsis at the greatest distance from the sun is called the *aphelion*, and at the greatest distance from the earth the *apogee*; while that at the least distance from the sun is termed the *perihelion*, and at the least distance from the earth the *perigee*.

APSIRTIDES. See Absorus.

APTA, or Apta Julia, (Pliny); now *Apte*, in Provence, on the river Calavon, seven leagues to the north of Aix, and nine to the north of Avignon. In the Notitiæ it is called *Civitas Aptensium*: Pliny reckons it among the Latin towns. That it was a colony, appears from an inscription on a stone found at Arles, (Sirmond). E. Long. 5. 56. Lat. 43. 23.

APTERA, (Strabo, Stephanus); APTERON, (Pliny); APTERIA, (Ptolemy): An inland town of Crete, whose port was Cisamus, on the west side of the island, (Strabo); 12 miles to the south of Sydonia towards the Montes Leuci, and as many from the Sinus Amphimales. So called from the Sirens, who, being there vanquished in song by the Muses, stript themselves of their wings, and out of grief leaped into the sea, (Stephanus). There was a town of Lycia of the same name. E. Long. 25. N. Lat. 35. 50.

APTERA, a term used by Linnæus for his seventh order of insects, comprehending such as have no wings.

APTHANE, a title anciently given to the higher degrees of nobility in Scotland. See THANE.

APTITUDE, (from *aptus* "fit"), the natural disposition any thing hath to serve for such or such a purpose.—Thus, oil hath an *aptitude* to burn, and water to extinguish fire.

APTITUDE, or APTNESS, is often used, in speaking of the talents of the mind, for a promptitude, or disposition to learn things with ease and expedition. In which sense *aptness* amounts to the same with what the Greeks call ευμαθια, *bona indoles*, and we sometimes *docility*. Charlton divides *aptness* into these parts, viz. *acuteness*, *sagacity* and *memory*.

APTOTE, among grammarians, an undeclinable noun, or one which has no variation of cases.

APULEIUS (Lucius), a Platonic philosopher, universally known by his performance of the Golden Ass. He lived in the second century, under the Antonines; and was born at Madaura, a Roman colony in Africa. He studied first at Carthage, then at Athens, and afterwards at Rome, where he learned the Latin tongue without the help of a master. He was a man of a curious and inquisitive disposition, especially in religious matters: this prompted him to take several journies, and to enter into several societies of religion. He spent his whole fortune almost in travelling; so that, at his return to Rome, when he was about to dedicate himself to the service of Osiris, he had not money enough to defray the expence attending the ceremonies of the reception, and was obliged to pawn his clothes to raise the necessary sum. He supported himself afterwards by pleading causes; and as he was a great master of eloquence, and of a subtile genius, many considerable causes were trusted to him. But he availed himself more by a good marriage than by his pleadings: a widow, named *Pudentilla*, who was neither young nor handsome, but wanted a husband and was very rich, took a great fancy to him. This marriage drew upon him a troublesome law-suit. The lady's relations, pretending he made use of sorcery to gain her heart and money, accused him of being a magician before Claudius Maximus proconsul of Africa. Apuleius was under no great difficulty of making his defence. As Pudentillo was determined from considerations of health, to enter upon a second marriage, even before she had seen this pretended magician, the youth, deportment, pleasing conversation, vivacity, and other agreeable qualities of Apuleius, were charms sufficient to engage her heart. He had the most favourable opportunities too of gaining her friendship, for he lodged some time at her house: Pudentilla's eldest son having a great friendship for him, was likewise desirous of the match, and solicited him in favour of Pudentilla. "Do you make a wonder (said Apuleius, in his defence) that a woman should marry again, after having lived a widow 13 years? it is much more wonderful that she did not marry again sooner. You think that magic must have been employed to prevail with a widow of her age, to marry a young man; on the contrary, this very circumstance shows how little occasion there was for magic." He offered to prove by his marriage-contract, that he got nothing of Pudentilla but a promise of a very moderate sum, in case he survived her and had children by her. He was also obliged to make such confessions in court as Pudentilla would gladly have excused. He said she was neither handsome nor young, nor such as could any ways tempt him to have recourse to enchantments; moreover, he added, that Pontianus her son proposed the marrying his mother to him only as a burden, and the action of a friend and philosopher. He also took notice of many inconveniences which attend the marrying of widows, and spoke highly of the advantages of a maid above a widow: "A handsome virgin (said he, let her be ever so poor, is abundantly portioned; she brings to her husband a heart quite new, together with the flower and first-fruits of her beauty. It is with great reason that all husbands set so great a value upon the flower of virginity: all the other goods which a woman brings her husband are of such a nature, that he may return them again, if he has a mind to be under no obligation her; that alone cannot be restored, it remains in the possession of the first husband. If you marry a widow, and she leaves you, she carries away all that she brought you." Upon which passage Mr Bayle makes a very coarse remark, *viz.* "That this good which is never taken back out of the hands of a husband, is very chimerical; and that there is never a baker nor a butcher, who would lend sixpence upon this unperishable possession." The apology is still extant, and is reckoned a very fine piece. Apuleius was extremely indefatigable in his studies; and composed several books, some in verse, and others in prose; but most of them have been lost. He took great pleasure in declaiming, and was heard generally with great applause: When he declaimed at Oeca, the audience cried out with one voice, that they ought to confer upon him the honour of citizen. The citizens of Carthage heard him with great satisfaction, and erected a statue to him; and several other cities did him the same honour. Several critics have published notes on Apuleius's Golden Ass, and there have been translations of it into different languages.

APULIA, now PUGLIA, a territory of Italy, bordering on the Adriatic, and extending from the river Frento to Tarentum in length, and from the Adriatic to the Lucani in breadth. *Apuli* the people, (Horace); divided into the *Apulia Daunia*, now called *Puglia Pinna*, or the *Capitanata*; and into the *Apulia Peucetia*, now *Terra di Barri*, (Pliny, Ptolemy.) Apulia abounded in sheep, which yielded the finest wool, (Martial). It is now the east side of the kingdom of Naples.

APUS, *Avis Indica*, in astronomy, a constellation of the southern hemisphere placed near the pole, between the triangulum australe and the chameleon, supposed to represent the bird of paradise.

APYCNI SUONI, in music, sounds distant one or more octaves, and yet concord.

APYCNOS, in music, is said of the diatonic genus, on account of its having spacious intervals, in comparison of the chromatic and enharmonic.

APYREXY, among physicians, denotes the intermission of a fever.

APYROUS, a word applied to denote that property of some bodies, by which they resist the most violent fire without any sensible alteration. Apyrous bodies ought to be distinguished from those which are refractory. Refractory substances are those which cannot by violent heat be fused, whatever other alteration they may sustain. But a body, properly speaking, apyrous, can neither be fused by heat, nor can undergo any other change. Diamonds were long thought to be possessed of this property. But some late experiments have shown, that diamonds may be entirely dissipated or evaporated by heat, and are therefore not intitled to be ranked among apyrous substances. Perhaps there is no body in nature essentially and rigorously apyrous. But it is sufficient that there be bodies apyrous relatively to the degree of fire which art can produce, to intitle them to that name.

AQUA, a term frequently met with in the writings of physicians, chemists, &c. for certain medicines, or menstruums, in a liquid form, distinguished from each other by peculiar epithets, as *Aqua Alexiteria*, *Aqua Aluminosa*, *Aqua Mirabilis*, *&c.* for which see PHARMACY.

Aqua Extincta, or *Extinguished Water*, is aquafortis into which some river-water has been poured, in order to qualify it, and render it less corrosive. Its use is to get the silver from the aquafortis that served to part gold from it.

Aqua Fortis, a name given by artists to nitrous acid of a certain strength, from its dissolving power: that which is concentrated and smoking, is called *spirit of nitre*. The aquafortis used by dyers, brass-founders, &c. is not only weaker than spirit of nitre, but contains a portion of vitriolic acid. It may be made by distilling crude nitre with calcined vitriol, equal parts. The nitrous acid, expelled by the vitriolic, will rise in red fumes, and pass into the receiver. The vitriolic acid, uniting with the alkaline basis of the nitre, forms vitriolated tartar; but, there being more vitriolic acid than is requisite to saturate the alkali, the surplus rises with the nitrous acid: aquafortis, therefore, is a mixture of these two acids. It may also be made by distilling crude nitre with somewhat more than half its weight of oil of vitriol; or by mixing one part of oil of vitriol with nine parts pure spirit of nitre. See CHEMISTRY-*Index*.

Aqua Marina, a name by which the jewellers call the beryl, on account of its sea-green colour. See BERYL.

Aqua Regia, a compound of nitrous and marine acid, in different proportions according to the purpose for which it is intended. It is usually made by dissolving, in nitrous acid, sal ammoniac, or common salt, both which are combinations of marine acid with alkali. When made with sal ammoniac, the common proportion is one part of this salt to four parts of nitrous acid; but to dissolve platina, equal parts are requisite. A purer aqua regia may be made by simply mixing the two acids.

Aqua regia is particularly used as a menstruum for gold; it likewise dissolves all other metals, except silver. The gold dissolved in aqua regia is, in fact, dissolved in the dephlogisticated marine acid only, which, being deprived of its phlogiston by the nitrous acid, recovers it from the gold, and thus renders gold soluble; for metals are not soluble in acids until they lose a part of their phlogiston. See CHEMISTRY-*Index*.

Aqua Secunda, aquafortis diluted with much pure water. It is employed in several arts, to clean the surface of metals and certain stones, and for various other purposes.

Aqua Vitæ, is commonly understood of what is otherwise called *brandy*, or spirit of wine, either simple, or prepared with aromatics. Some, however, distinguish between them; appropriating the term *brandy* to what is drawn from wine, or the grape; and *aqua vitæ* to that drawn after the same manner, from malt, &c.

Aquæ Augustæ, (Ptolemy); *Aquæ Tarbellicæ*, (Antonine); *Aquensis Civitas*, in the Notitia. Now *Acqs*, or *Dax*, a town in Gascony, on the river Adour, famous for its baths. W. Long. 1. 40. N. Lat. 43. 56.

Aquæ Bilbilitanæ, (Antonine); baths 24 miles to the west of Bilbilis. Now *Banos de Alhama*, in Arragon.

Aquæ Calidæ, (Ptolemy); *Aquæ Solis*, (Antonine); a place of the Belgæ in Britain, famous for its hot waters. Now *Bath*, in Somerset-shire. W. Long. 1. 5. Lat. 51. 20.

Aquæ Calidæ, (Ptolemy); *Aquicaldensis*, (Pliny); formerly in great repute, and a public bath; whose ruins still remain testimonies of the Roman grandeur. Now *Orense*, in Gallicia, still famous for its baths; on the river Minho, 54 miles south-east of Compostella. W. Long. 8. 30. Lat. 42. 30. Also a place in the bay of Carthage, (Strabo). Other *Aquicaldenses*, to the north of Gerundia in Catalonia, (Ptolemy).

Aquæ Calidæ, a colony between the rivers Serbetes and Savus, in Mauritania Cæsariensis, (Ptolemy).

Aquæ Celeniæ, (Ptolemy); or *Cilinæ*, (Antonine). Now *Caldas*, a hamlet on the Minho, in Gallicia.

Aquæ Convenarum, a hamlet of Gaul, in Aquitaine, (Antonine), and on the borders of the Convenae, or le Cominge, at the foot of the Pyrenees, near the source of the Garonne. Now Bagneres. W. Long. 3. 39. Lat. 42. 20.

Aquæ Cutiliæ, a lake of the Sabines, in the territory of Reate (Pliny); *Lacus Cutiliensis*, (Varro); with a moveable island in it, (Seneca, Pliny); supposed to be the centre of Italy, (Varro). The waters were medicinal, and extremely cold, good for a weak stomach and in weak nerves; they seemed to act by a kind of suction, which approached to a bite, (Pliny). Vespasian used them every summer; and there he died, (Sueton, Xiphilin from Dio). Now *Lago di Contigliano*.

Aquæ Flaviæ, a town on the confines of Gallicia and Portugal, so called from Vespasian and Titus. The inhabitants are called *Aquiflavienses*, coins. Now called *Chiavas*, a mean hamlet: but the ruins of its bridge testify its former grander. W. Long. 6. 6. Lat. 41. 40.

Aquæ Helvetiæ, described by Tacitus as a municipal town, and much frequented for its excellent water; and though he does not mention its name, Cluverius sup-

supposes it to be Baden, in Switserland, on the rivulet Limat, which soon after falls into the Aar. It is called the Upper, to distinguish it from another called the Lower Baden in Alsace. E. Long. 8. 49. Lat. 47. 55.

Aquæ Merom (Joshua), famous for the defeat of Jabin; supposed to be the lake called *Samachonitis*, or *Semechonitis*, by Josephus; into which the river Jordon falls, before it comes to the sea of Genesereth, or Galilee.

Aquæ Pannoniæ, famous baths of Austria, now called *Baden*, 28 miles to the south of Vienna.

Aquæ Patavinæ, are baths in the territory of Venice near Padua, (Pliny); called *Fontus Aponi* (Livy, Martial). Now *Bagni d'Abano*. E. Long. 31. 48. Lat. 45. 15.

Aquæ Quintianæ, put by Ptolemy in room of the *Aquæ Cilinæ* of Antonine. Now supposed to be *Sarria*, a town of Gallicia, on a rivulet of the same name, three leagues to the south of Lugo.

Aquæ Sextiæ, a colony to the north of Marseilles, so called, both from the founder Sextius Calvinus, and from its quantity of water, and number of cold and hot springs; built after the defeat of the Salyes, or Salvii, whose territory in the south of Provence reached from the Rhone to the borders of Italy, (Livy, Velleius, Strabo, Ptolemy). By an inscription the colony appears to have been either increased or renewed by Augustus. In the Notitia it is called *Civitas Aquensis*. Now *Aix*. Here the Teutones and Cimbri were defeated with a great slaughter by Marius. E. Long. 6. 4. Lat. 48. 4.

Aquæ Statiellæ or *Statiellorum*, (Pliny), a town in Liguria, on the river Bormia. Now *Acquic*, a town of Montferrat. E. Long. 8. 40. Lat. 44. 45.

Aquæ Tauri, hot waters or baths in Tuscany, at the distance of three miles from the sea, said to be discovered by a bull, hence the appellation. There are still to be seen the ruins of these baths. Now *Acquapendente*, in Orvieto. E. Long. 12. 40. Lat. 42. 40.

AQUÆDUCT, in hydraulics and architecture, a structure formed for conveying water from one place to another, over grounds that are unequal. The word is compounded of the Latin substantive *aqua* water, and *ductus* a channel by which that water may be conducted.

Architects distinguish two kinds of aquæducts, the *visible*, and the *subterraneous*.—The *visible* are constructed in valleys or marshes, and protracted in longitude or latitude as the situation requires. They are composed of adminicula for supporting the arches and confining the stream, and of arcades.—The *subterraneous* are formed, by piercing the mountains, and conducting them below the surface of the earth. They are built of stone, hewn or rough; and covered above with vaults, or with flat stones, which may be termed *flags*: these flags shelter the waters from the heat of the sun.

They divide them still into *double* and *triple* aquæducts; that is to say, such as are supported either by two or by three ranges of arcades. Such was the aqæduct which Procopius records to have been built by Cosroës king of the Persians, for the city of Petra in Mingrelia: It had three conduits upon the same line, each elevated above the other.

Frequently aquæducts are paved. Sometimes the waters flow through a natural channel of clay. Frequently they are conveyed by pipes of lead into reservoirs of the same metal, or into troughs of hewn stone. The channels are cut with an imperceptible descent, that the current may be accelerated by its own weight. Parallel to its course, on each side, is cut a narrow foot path, where people may walk when necessary. By conduits, or grooves, the waters are conveyed into large cisterns, but not forced above their original level. To make them rise and issue from their apertures with force, they must be confined in tubes of a small diameter, and abruptly fall from a considerable declivity.

Aquæducts of every kind were long ago the wonders of Rome; the vast quantity of them which they had; the prodigious expence employed in conducting waters over arcades from one place to another, at the distance of 30, 40, 60, and even 100 miles, which were either continued or supplied by other labours, as by cutting mountains and piercing rocks; all this ought to surprise us; nothing like this is undertaken in our times: we dare not even think of purchasing public conveniency at so dear a rate. Appias the censor advised and constructed the first aquæduct. His example gave the public luxury a hint to cultivate these objects; and the force of prodigious and indefatigable labour diverted the course of rivers and floods to Rome. Agrippa, in that year when he was ædile, put the last hand to the magnificence of these works. It is chiefly in this respect that the modern so much resembles the ancient city of Rome. For this advantage, she is peculiarly indebted to Sextus V. and to Paul V. who for grandeur and magnificence emulated the masters of the universe*. There are still to be seen, in different places contiguous to Rome, striking remains of these aquæducts; arches continued thro' a long space, over which were extended the canals which carried the water to the city. The arches are sometimes low, sometimes raised to a vast height, to humour the tumidities or depressions of the ground. There are some which have two arcades, one constructed above the other; and this precaution was observed, lest the height of a single arcade, if extended as far as the situation required, might render the structure less firm and permanent. They are commonly of bricks; which by their cement cohere so strongly, that the parts are not separated without the utmost difficulty—When the elevations of the ground were enormous, it became necessary to form *subterraneous* aquæducts. These carried the waters to such aquæducts as were raised above ground, in the declivity or at the foot of mountains. If the artificial channel of the water was not susceptible of a downward bias but by passing through a rock, through this they cut a passage at the same height with the superior aquæduct: such an one may be seen above the city of Tivoli, and at the place called *Vicavaro*. The canal which formed the course of the aquæduct is hewn out of the rock to the extent of more than a mile, about five feet in height and four in breadth.

* See *New Memoirs of Italy*, vol. i.

There is one thing, however, which deserves to be remarked. It is, that the aquæducts, which might have been directed in a straight line to the city, did not arrive at it but by frequent and winding mazes. Some have said that this oblique tract was pursued to avoid the expence which must attend the building of arcades to an extraordinary height: others, that it was their intention to diminish the impetuosity of the current; which,

which rolling in a straight line through an immense space, must always have increased its velocity, must have worn the canals by perpetual and forcible attrition, and of consequence afforded an impure and unwholesome draught to the inhabitants. But since there was so great a descent between the cascade of Tivoli and Rome, it is demanded why they should go to draw water from the same river at the distance of more than 20 miles higher; nay, of more that 30 miles, if we reckon the curvatures of its direction through that mountainous country? It is replied, the motive of obtaining the water more salubrious, and more limpid, was sufficient to make the Romans think their labour necessary, and their expence properly bestowed; and to those who reflect that the waters of this river were impregnated with mineral particles, and by no means wholesome, the answer will appear satisfactory.

Vol. IV. If any one will cast his eyes upon plate 128th of the Antiquities of Father Montfaucon, he will see with how much care these immense works were constructed. From distance to distance spiramenta were left, that, if the water should happen to be stopped by any accident, it might gradually disemboge, till they could clear its ordinary passage. There were likewise, even in the very canals which conveyed the water, cavities considerably deeper than its internal surface, into which the stream was precipitated, and where it remained stagnant till it was refined from mud and feculence; and ponds, where it might expand itself till it was purified.

The aquæduct of the *aqua Marcia* had an arch of 16 feet in diameter. The whole was composed of three different kinds of stone; one of them reddish, another brown, and a third of an earth colour. Above, there appeared two canals; of which the highest was fed by the new waters of the Tiverone, and the lower by what they call the *Claudian* river. The entire edifice is 70 Roman feet high. Near this aquæduct, we have in Father Montfaucon the plan of another with three canals; the highest supplied by the water called *Julia*, that in the middle from Tepula, and the lowest from the aqua Marcia.

The arch of the aquæduct of the aqua Claudia is of hewn stone, very beautiful; that of the aquæduct of the aqua Neronia is of bricks: they are each of them 72 Roman feet in height.

The canal of the aquæduct which was called the *aqua Appia*, deserves to be mentioned for a singularity which is observed in it; for it is not, like the others plain, nor gradual in its descent; but much narrower at the lower than the higher end.

The consul Frontinus, who superintended the aquæducts under the emperor Nerva, mentions nine of them which had each 13,594 pipes of an inch in diameter. Vigerus observes, that, in the space 24 hours, Rome received 500,000 hogsheads of water.

We might likewise have mentioned the aquæduct of Drusus, and that of Riminius: but we shall satisfy ourselves with observing here, that Augustus caused all the aquæducts to be repaired; and afterwards pass to other monuments of the same kind, and still more important, which give the most striking ideas of Roman magnificence.

One of these monuments is the aquæduct of Metz, of which a great number of arcades still remain. These arcades crossed the Moselle, a river which is broad and vast at that place. The copious sources of Gorze furnished water for the representation of a sea-fight. This water was collected in a reservoir: from thence it was conducted by subterraneous canals formed of hewn stone, and so spacious that a man could walk erect in them: it traversed the Moselle upon its superb and lofty arcades, which may still be seen at the distance of two leagues from Metz; so nicely wrought and so firmly cemented, that, except those parts in the middle which have been carried away by the ice, they have resisted, and will still resist, the severest shocks of the most violent seasons. From these arcades, other aquæducts conveyed the waters to the baths, and to the place where the naval engagement was mimicked.

If we may trust Colmenarus, the aquæduct of Segovia may be compared with the most admired labours of antiquity. There still remain 159 arcades, wholly consisting of stones enormously large, and joined without mortar. These arcades, with what remains of the edifice, are 102 feet high; there are two ranges of arcades, one above another. The *aquæduct* flows thro' the city, and runs beneath the greatest number of houses which are at the lower end.

After these exorbitant structures, we may be in some degree believed when we speak of the *aquæduct* which Lewis XIV. caused to be built near Maintenon, for carrying water from the river Bucq to Versailles: it is perhaps the greatest aquæduct which now subsists in the world; it is 7000 fathoms in length, above 2560 in height, and contains 242 arcades.

AQUAMBOE, one of the greatest monarchies on the coast of Guinea in Africa, stretching 20 miles in breadth, and ten times that space in length from east to west. According to Bosman, the coast is divided into a great number of petty royalties, but all of them subject to the king of Aquamboe, who indiscrimately uses an unlimited authority over them and the meanest of his subjects. His despotism gave rise to a proverbial saying, that "there are only two ranks of men at Aquamboe; the royal family, and slaves." The natives of this country are haughty, turbulent, and warlike; and their power is formidable to all the neighbouring nations. They grievously infest such nations as are tributaries to the king of Aquamboe, entering their territories by troops, and carrying off from the inhabitants whatever they think proper; nor do they ever meet with any opposition from the inhabitants, as they are sensible the king would not fail to resent this as an indignity offered to him.

AQUARIANS, Christians in the primitive church who consecrated water in the eucharist instead of wine. This they did under pretence of abstinence and temperance; or, because they thought it universally unlawful to eat flesh or drink wine. Epiphanius calls them *Encratites*, from their abstinence; St Austin, *Aquarians*, from their use of water; and Theodoret, who says they sprang from Tatian, *Hydroporastatæ*, because they offered water instead of wine.

Besides these, there was another sort of Aquarians, who did not reject the use of wine as unlawful; for they administered the eucharist in wine at evening service: but, in their morning assemblies, they used water, for fear the smell of wine should discover them to the heathens.

AQUARIUS, the WATER-CARRIER, in astronomy, the

Aquartia || Aquatinta.

the 11th sign is the zodiac, reckoning from Aries; from which also the 11th part of the ecliptic takes its name.—The sun moves through Aquarius in the month of January; it is marked thus, ♒.

The poets feign, that Aquarius was Ganymede, whom Jupiter ravished under the shape of an eagle, and carried away into heaven, to serve as a cup-bearer, in the room of Hebe and Vulcan; whence the name.—Others hold, that the sign was thus called, because, when it appears in the horizon, the weather usually proves rainy.

The stars in the constellation Aquarius, in Ptolemy's catalogue, are 45; in Tycho's 41; in Hevelius's 47; in Flamstead's 108.

AQUARTIA, in botany, a genus of the tetrandria monogynia class. The calyx is campanulated; the corolla is rotated, with linear divisions; and the berry is four-seeded. There is but one species, the *aculeata*, a native of America.

AQUATIC, in natural history, an appellation given to such things as live or grow in the water.

AQUATINTA, a method of etching on copper, lately invented, by which a soft and beautiful effect is produced, resembling a fine drawing in water-colours or Indian ink.

Previous to the operation upon the plate, the following powder must be prepared.—Take of asphaltum and fine transparent rosin, equal parts, suppose two ounces of each, and pound them separately. Through a muslin sieve (which may be formed with part of a chip-box of three or four inches diameter) sift upon a sheet of paper a thin stratum of the asphaltum, above which sift a similar layer of the rosin, and upon this another layer of asphaltum, continuing these alternate layers till both of the powders are exhausted: then pass the mixture through the same sieve upon the paper once or twice, or till both appear to be sufficiently incorporated; when the powder is ready for use. Some, instead of the above mixture, use gum sandarach pounded.

The main process is as follows.—A copper-plate being polished in the usual way, lay the etching ground upon it, and etch the outlines of your design in the manner directed under the article ETCHING: The ground is then to be softened with a little grease, and wiped off with a piece of rag; leaving, however, as much grease upon the plate as just to dim the copper. You now sift your powder upon the surface of the plate; after which, strike the other side of it pretty smartly against the edge of the table, in order to discharge it of the loose powder: This done, with a hand-vice hold the back of the plate over a chaffing-dish of charcoal fire, till it become so hot as to give pain upon being touched with the back of the hand; and the powder which adhered to the grease will now be fixed to the plate. The plate being then suffered to cool, take turpentine varnish, mixed with ivory black; and with a hair-pencil dipt in it, cover all the lights or places where there is no work or shades. A rim or border of bees-wax is now to be raised round the plate: Then having reduced the aquafortis to a proper strength by vinegar or water, you pour it on, and let it stand five minutes for the first or lightest shade: after which, pour it off; and having washed the plate with water, set it on edge to dry: Then with the varnish stop up your light shades, pour on the aquafortis for the second tint, and let it stand five minutes more; proceeding in the same manner for every tint till you produce the darkest shades. If a bold open ground is wanted in any part, this requires an after-operation: The ground must be laid as the other, by sifting on the powder; only this powder is much coarser, and the plate must be much more heated in order that the particles of the powder may spread, and form small circles: even good clean rosin will do by itself.

Aquatinta || Aquila.

In etching landskips, the sky and distant objects are also performed by a second operation, and the powder is sifted upon the plate with a finer sieve. If the trees or any part of the fore-ground require to be higher finished, the plate must be entirely cleansed from grease with bread, and a ground laid in the common way of etching; when you may finish as highly and neatly as you please with the needle or point, by stippling with dots, and biting up those parts, or by a rolling-wheel.

The preceding is the method for prints of one single tint. But if different colours are to be expressed, there will be requied as many different plates, each plate having only the part etched upon it which is designed to be charged with its proper colour: unless (as many happen in particular subjects) some of the colours are so distant from each other as to allow the printer room to fill them in with his rubber without blending them; in which case, two or more different colours may be printed from the same plate at once.—Where different plates are necessary, a separate one, having a pin in each corner, must be provided as a sole or bottom to the aquatinta plates; and these again must be exactly fitted, having each a small hole in their corners for passing over the pins of the sole: the said pins serving the double purpose of retaining the plates successively in their due position, and of directing the printer in placing the paper exactly on each plate so as not to shift: by which means each tint or colour will be exactly received on its proper place.—This is the method practised at Paris. A landscape or similar subject, however may be printed off at once in the different proper colours, by painting these upon the plate. In this case, the colours must be pretty thick in their consistence; and the plate must be carefully wiped in the usual way after the laying on of each tint, as well as receive a general wipe upon its being charged with all the tints.

This art is kept as secret as possible by those who practise it; and it is believed that no particular explanation or directions, before the present, have been communicated to the public. In order to succeed, however, great care and judgment are requisite; and much depends upon a certain nicety of management, which is only attainable by practice.

AQUAVIVA, a town of the kingdom of Naples, and province of Barri.

AQUEDUCT. See AQUÆDUCT.

AQUEOUS, in a general sense, something partaking of the nature of water, or that abounds with it.

Aqueous Humour. See ANATOMY, p. 767.

AQUILA, in ornithology, a synonime of the eagle. See FALCO.

AQUILA, the EAGLE, in astronomy, a constellation of the northern hemisphere; usually joined with Antinous.

The

Aquilegia. The stars in the constellation Aquila and Antinous, in Ptolemy's catalogue, are 15; in Tycho's, 19; in Hevelius's, 42; in the Britannic catalogue, 71.

AQUILA, a fine large city of Italy, and the capital of Abruzzo, seated on a hill, on the banks of the river Pescara, near its source. It has an ancient castle, and is a bishop's see immediately under the pope. The land about it produces great plenty of saffron. It was very near being all destroyed by an earthquake, in February 1703. The first shock was so terrible, that the inhabitants abandoned the city; but returning to vespers, it being Candlemas-day, the shocks followed one another with such violence, that 24,000 people perished, and great numbers were wounded; 800 were killed in one single church: many other churches, monasteries, noble buildings, and the town-house, were either swallowed up or overturned, together with the greater part of the city and its walls. Aquila stands 30 miles from the sea, and about 16 from the confines of the pope's dominions. E. Long. 14. 20. N. Lat. 42. 20.

AQUILEGIA, COLUMBINE: A genius of the pentagynia order, belonging to the polyandria class of plants; and, in the natural method, ranking under the 26th order, *Multisiliquæ*. It has no calyx; the petals are five, with a horn-like nectarium inserted between each; and there are five separate capsules.

Species. 1. The vulgaris, or wild columbine, with blue flowers, is found growing wild in some woods of England. 2. The alpina, with long oval flowers, grows naturally near Ingleborough-hill in Yorkshire. The flowers are much larger than those of the garden columbine. 3. The inversa, or garden columbine. Of this there are great varieties, not only in the colour and fulness of their flowers, but also in their form. These are commonly called *rose-columbines*; the colours are chesnut, blue, red, and white, and some are finely variegated with two colours. There are others with sharp-pointed petals in form of a star, and of these there are single and double flowers of the same colours with the former. 4. The canadensis, or Canada columbine, flowers almost a month before the other sorts, and therefore is preserved in the gardens of the curious, though not at all remarkable for its beauty. There is a variety of this with taller flower-stems.

Culture. These plants are all propagated by sowing the seeds, or parting the old roots; but the former method is chiefly practised, for the old roots are very apt to degenerate. The seeds should be sown in a nursery-bed in August or September; for those which are kept till the spring seldom grow well, or at least remain in the ground a whole year. The spring following the plants will appear above ground, and should be kept clear of weeds; and if the season proves dry, they must be watered. In the middle or latter end of May they will be strong enough to transplant; for which purpose, some beds of good undunged earth should be prepared, planting them therein at eight or nine inches distance from each other. In the following autmn, by which time the plants will have acquired strength enough to flower the year following, the roots should be carefully taken up and planted in the borders of the flower-garden: but where their roots are designed to be preserved in perfection, all the flower-stalks must be cut off as soon as the flowers are past. In order to keep up a succession of good flowers, fresh seeds should be sown every year; and it will likewise be advantageous to exchange the seeds with some brought from a distant place.

Aquileia

Medicinal Uses. Columbine has been looked upon as aperient; and was formerly in great esteem among the common people for throwing out the small-pox and measles. A distilled water, medicated vinegar, and conserve, were prepared from the flowers; but they have long given place to medicines of greater efficacy.

AQUILEIA, a large city of the Carni, or Veneti, and a noble Roman colony, which was led thither between the first and second Macedonian wars, (Livy). It is washed by two rivers, the Natiso aud Turrus, (Pliny.) The reason of leading this colony was, in order to be a bulwark against the neighbouring barbarians. The colony was afterwards increased with 1500 families by a decree of the senate, (Livy); from which it became a very famous port-town, (Herodian). The emperor Julian ascribes the appellation to the augury of an eagle at the time of building it; but Isaac Vossius on Mela, to the great plenty of water, as if the town were called *Aquilegia*. The harbour, at the mouth of the Natiso, is distant 60 stadia from the city; so that ships of burden are towed up the river, (Strabo). In 452 it was besieged by Attila with an innumerable host of barbarians. The walls were assaulted by a formidable train of battering rams, moveable turrets, and engines, that threw stones, darts, and fire; and the monarch of the Huns employed the forcible impulse of hope, fear, emulation, and interest, to subvert the only barrier which delayed the conquest of Italy. Aquileia was at that period one of the richest, the most populous, and the strongest of the maritime cities of the Hadriatic coast. Three months were consumed without effect in the siege; till the want of provisions and the clamours of his army compelled Attila to relinquish the enterprise, and reluctantly to issue his orders that the troops should strike their tents the next morning and begin their retreat. But as he rode round the walls, pensive, angry, and disappointed, he observed a stork preparing to leave her nest in one of the towers, and to fly with her infant family towards the country. He seized, with the ready penetration of a statesman, this trifling incident which chance had offered to superstition; and exclaimed, in a loud and cheerful tone, that such a domestic bird, so constantly attached to human society, would never have abandoned her ancient seats, unless those towers had been devoted to impending ruin and solitude. The favourable omen inspired an assurance of victory; the siege was renewed and prosecuted with fresh vigour; a large breach was made in the part of the wall from whence the stork had taken her flight; the Huns mounted to the assault with irresistible fury; and the succeeding generation could scarcely discover the ruins of Aquileia. The place, however, which is still called Aquileia, there are several inscriptions and antiquities to be seen in it, which are worthy of a traveller's notice; and, though dwindled into a poor village, it gives a title to the patriarch of Aquileia. The patriarch is named by the Venetians, and resides at Udino, because the town of Aquileia belongs to the House of Austria. E. Long. 13. 30. Lat. 46. 20.

ACQUILICIUM, or Acquiliciana, in Roman antiquity, sacrifices performed in times of excessive drought, to obtain rain of the gods.

AQUILINE, something belonging to or resembling an eagle: Thus, an aquiline nose is one bent somewhat like an eagle's beak.

AQUILO, is used by Vitruvius for the north-east wind; or that which blows 45° from the north towards the east point of the horizon.—The poets gave the name *aquilo* to all stormy winds dreaded by the mariner.

AQUILUS, among the ancients, a dark or dusky colour approaching to black.—Hence some of the Heathen gods were called *dii aquili*, q. d. *nigri*.

AQUIMINARIUM, in antiquity, a kind of lustral vessel, wherein the Romans carried their holy water for expiation, and other religious offices.

AQUINAS (St Thomas), styled the *Angelical Doctor*, was of the ancient and noble family of the counts of Aquino, descended from the kings of Sicily and Arragon; and was born in the castle of Aquino, in the Terra di Lavora in Italy, in the year 1224 or 1225. He entered into the order of the Dominicans; and, after having taught school-divinity in most of the universities of Italy, at last settled at Naples: where he spent the rest of his life in study, in reading of lectures, and in acts of piety; and was so far from the views of ambition or profit, that he refused the archbishoprick of that city, when it was offered him by Pope Clement IV. He died in 1274, leaving an amazing number of writings, which were printed at Venice in 17 vols. folio, in the year 1490. He was canonized by Pope John XXII. in the year 1323; and Pius V. who was of the same order with him, gave him, in 1567, the title of the Fifth Doctor of the church, and appointed his festival to be kept with the same solemnity as those of the other four doctors. His authority has always been of great importance in the schools of the Roman Catholics. Lord Herbert, in his life of Henry VIII. tells us, that one of the principal reasons which induced that king to write against Luther was, that the latter had spoken contemptuously of Aquinas.

AQUINO (Philip d'), in Latin *Aquinas* or *Aquinius*, having turned from Judaism, had a pension from the clergy of France; and acquired much reputation by his knowledge of the Hebrew language, which he taught at Paris, in the reign of Lewis XIII. and by the books he published, among which is his *Dictionarium Hebræo-Chaldæo-Thalmudico-Rabbinicum*. His grandson, Anthony D'Aquin, was first physician to Lewis XIV.

Aquino, a town of Italy, in the kingdom of Naples, and Terra di Lavora; a bishop's see, but ruined by the emperor Conrade, and now consisting of about 35 houses. It was the birth-place of the poet Juvenal, and of Thomas Aquinas. E. Long. 14. 30. N. Lat. 41. 32.

AQUINUM, (anc. geog.) a large municipal town, and a Roman colony on the borders of the Samnites, washed by the river Melpha (Strabo). The birthplace of Juvenal, as he himself testifies. The inhabitants are called *Aquinates*; now *Aquino*, but almost in ruins, in the territory of Lavoro. E. Long. 17. 11. Lat. 41. 35.

AQUITANIA (anc. geog.), one of the three principal divisions of Gallia Comata (Cæsar); bounded by the Garonne, the Pyrenees, and the Ocean: this is the *Aquitania Cæsariana*, or *Vetus*. Augustus set different boundaries, viz. the Loire, the Cevennes, the Pyrenees, and the Ocean (Strabo). It was called *Gallia Aquitanica* (Pliny); and in the old Notitiæ, *Provincia Aquitanica*. The people are called *Aquitani* (Cæsar). Now comprising Guienne (which seems to be a corruption of Aquitania) and Gascony.

AR (anc. geog.), the metropolis of Moab, in Arabia Petræa (Moses); and the royal residence situate on the east side of the river Arnon. It was called also *Rabba* (Joshua;) and to distinguish it from Rabba of the Ammonites, *Rabbat Moab*, and on coins *Rabbath Moma* (Reland.) Eusebius says it was called *Areopolis* in his time, from *Ar* and *Polis*. The inhabitants are called *Areopolitæ*. St Jerom says that this city was entirely destroyed by an earthquake when he was a young man.

ARA thuribuli, the altar of incense, in astronomy, a southern constellation, not visible in our hemisphere, consisting, according to Ptolemy, of seven stars; and according to Sharp's catalogue, annexed to that of Mr Flamstead, of nine stars.

Ara, in astronomy, a southern constellation, containing eight stars.

ARAB, or Arabian horse. See Equus.

ARABESQUE, or Arabesk, something done after the manner of the Arabians. *Arabesque*, *Grotesque*, and *Moresque*, are terms applied to such paintings, ornaments of freezes, &c. wherein there are no human or animal figures but which consist wholly of imaginary foliages, plants, stalks, &c. The words take their rise from hence, that the Moors, Arabs, and other Mahometans, use these kinds of ornaments; their religion forbidding them to make any images or figures of men or other animals.

ARABIA, a country of Asia, famous from the remotest antiquity for the independency of its inhabitants during the vast conquests of the Assyrians, Persians, Greeks, and Romans, and, in latter times, for being the centre of an empire equal, if not superor, in extent to any that ever existed.

1 Whence named.

This country, or at least the greatest part of it, was in the earliest ages called *Arabah*. Concerning the etymology of which word there are various conjectures. It has most generally been derived from the Hebrew word ארב, signifying, *the west*, *mixture*, or *traffic*; but, according to M. Volney, *Arab*, in the ancient language of these countries, signifies a *solitude* or *desart*. In its largest extent, Arabia lies between the 12th and 35th degrees of N. Lat. and the 36th and 61st of E. Long. It greatest length from north to south is about 1430 miles, and its breadth from east to west is 1200. It is bounded on the west by Palestine, part of Syria, the isthmus of Suez, and the Red sea, called by the Arabs the sea *Al Kolzom*; on the east by the Euphrates, the Persian gulf, and bay of Ormos; on the north, by part of Syria, Diyar-Becr, Irak, and Khuzestan: and on the south by the straits of Babel-Mandel and the Indian ocean. It grows narrower as we approach the frontiers of Syria and Diyar-Becr; and, by reason of the proximity of the Euphrates to the Mediterranean, may be looked upon as a peninsula,

2 Boundaries &c.

ninſula, and that one of the largeſt in the whole world. —Arabia Proper, however, is much narrower, including little more than what was comprehended by the ancients under the name of Arabia Felix, which we ſhall preſently deſcribe; and here the Arabs have been ſettled almoſt ſince the flood.

3 Diviſion.

The firſt diviſion of the peninſula of Arabia was into *Arabah* and *Kedem*, as we learn from ſcripture; the firſt of which implied the weſt, and the other the eaſt, denoting the ſituation of the two countries.—Ptolemy was the firſt who divided the peninſula we ſpeak of into three parts, Arabia Petræa, Arabia Deſerta, and Arabia Felix, which diviſion has generally prevailed ſince his time.

Arabia Petræa, on the eaſt, was bounded by Syria and Arabia Deſerta; on the weſt, by Egypt, or rather the iſthmus of Suez which ſeparates Aſia from Africa, and the Heroopolitan gulph or weſtern arm of the Red Sea; on the north, by Paleſtine, the lake Aſphaltites, and Cœloſyria; and on the ſouth by Arabia Felix. This tract did not admit of much cultivation, the greateſt part being covered with dry ſands, or riſing into rocks, interſperſed here and there with ſome fruitful ſpots. Its metropolis was Petra, which by the Syrians was ſtiled *Rakam*, and in ſcripture *Joktheel*. Several other cities of Arabia Petræa are mentioned by Ptolemy; but as it is very improbable ſuch a barren country ſhould abound with large cities, we muſt look upon them as inconſiderable places.

Arabia Deſerta was bounded on the north by the Euphrates, which ſeparated it from Meſopotamia; on the weſt, by Syria, Judæi, and Arabia Petræa; on the eaſt by a ridge of mountains which ſeparated it from Babylonia and Chaldæa; on the ſouth, by Arabia Felix, from which it was likewiſe ſeparated by ſeveral ridges of hills. By far the greateſt part of this kingdom, as well as the former, was a loneſome deſart, diverſified only with plains covered with ſand, or mountains conſiſting of naked rocks and precipices; nor were they ever, unleſs ſometimes at the equinoxes, refreſhed with rain. The few vegetables which they produced were ſtinted by a perpetual drought, and the nouriſhment afforded them by the nocturnal dews was greatly impaired by the heat of the ſun in the day time. Throughout the deſarts were found huge mountains of ſand, formed by the violence of the winds that continually blew over them in the day-time, though they ceaſed in the night. Wells and fountains were for the moſt part exceedingly rare; however, notwithſtanding the ſterility of theſe countries, the vaſt plains of ſand juſt now mentioned were interſperſed with fruitful ſpots, which appeared here and there like ſo many iſlands in the midſt of the ocean. Theſe being rendered extremely delightful by their verdure, and the more ſo by the neighbourhood of thoſe frightful deſarts, the Arabs encamped upon them: and having conſumed every thing they found upon one, removed to another, as is the cuſtom of their deſcendants the Bedoweens at this day. Theſe fruitful ſpots were likewiſe frequent in Lybia, and by the Egyptians called *auaſes* or *abaſes*, as we learn from Strabo. The barren part of Arabia Felix bordering upon the Red Sea, was in like manner interſperſed with abaſes; which probably gave the name of *Abaſeni* to a nation ſettled there, and in the adjacent fertile region. A body of theſe, it is ſaid, croſſing the ſtraits of Babel-Mandel, paſſed into Ethiopia, which from them received the name of *Abaſſia*. From this account of Arabia Deſerta, we may reaſonably conclude, that the towns ſaid by Ptolemy to have been ſituated in it were places of very little conſequence.

Arabia Felix was bounded on the north by the two kingdoms juſt deſcribed; on the ſouth, by the Red Sea; on the eaſt and weſt, by part of that ſea, together with the Arabian and Perſian gulfs. In Strabo's time, it was divided into five provinces, by the oriental hiſtorians called *Yaman*, *Hejaz*, *Tehâma*, *Najd*, and *Yamana*. In this diſtrict ſtood ſeveral towns, particularly Nyſa, famous for being the birth-place of Bacchus; and Muſa, or Muza, a celebrated emporium or harbour, where the Arabian merchants reſorted with their frankincenſe, ſpices, and perfumes. Theſe two were ſituated in the province of Yaman. In that of Hejaz ſtood the ſtill more famous cities of Mecca and Medina; alſo Thaiſa or Taiſa, Gjudda or Jodda, Yanbo or Al Yanbo, and Madian, the Modiana of Ptolemy, and the Midion or Madian of Scripture.

4 When peopled.

At what time the abovementioned kingdoms were firſt peopled we have no certain accounts. The moſt conſiderable nations inhabiting Arabia Petræa, in the early ages, were the Iſhmaelites, the Nabatei or Nabatheans, the Cedræi or Kedareni, and the Agareni or Hagareni; and of theſe the Iſhmaelites were the moſt powerful, if they did not comprehend all the reſt; and if the Hagareni were not the ſame people with them, they muſt at leaſt have been nearly related. Kimſhi, an oriental hiſtorian, inſinuates, that they were originally the children of Hagar by an Arab, after ſhe had left Abraham. In after ages, the names of all the nations ſituated here were abſorbed in that of *Saracens*, by which the Iſhmaelites are diſtinguiſhed in the Jeruſalem Targum. A nation alſo is mentioned by Pliny, called *Arraceni*, and *Saraceni* by Ptolemy and Dioſcorides, which was probably no other than the Iſhmaelites above mentioned In Arabia Deſerta ſeveral tribes reſided, all of whom were very obſcure, except the Aiſitæ and Agræi. The former are ſuppoſed by Bochart to have been Job's countrymen, and the latter to have been the ſame with the Hagareni, Arraceni, or Saraceni, abovementioned. Arabia Felix was inhabited by many different tribes; the moſt remarkable of which were the Sabæi, Gerræi, Minæi or Minnæi, Atramitæ, Maranitæ, Catabani, Aſcitæ, Homeritæ, Sapphoritæ, Omanitæ, Saraceni, Nabathæi, Thamydeni, and Bnizomenæ; but neither their limits nor ſituation can now be determined with any manner of preciſion.

5 Diviſion of the Arabs.

According to the oriental hiſtorians, the Arabs are to be divided into two claſſes; *viz.* the *old loſt Arabians*, and the *preſent*. The moſt famous tribes among the former were thoſe of Ad, Thamud, Taſm, Jadês, Jorham, Amalek, Amtem, Haſbem, Abil, and Bâr. Concerning theſe, though now entirely loſt and ſwallowed up among other tribes, there are ſome remarkable traditions, of which the following may ſerve as a ſpecimen.

6 Tradition concernidg the tribe of Ad.

The tribe of Ad deduced their origin from Ad the ſon of Aws, or Uz, the ſon of Aram, the ſon of Shem, who, after the confuſion of tongues, ſettled in Al Abkaf, or the winding ſands in the province of Hadramant, on the confines of Yaman, where his poſterity greatly

Arabia.

greatly multiplied. Their first king was Sheddâd, the son of Ad, who built a stately palace and made a delightful garden in the desarts of Aden, which he designed as an imitation of the celestial paradise. This garden he called *Irem:* and when it was finished, he set out with a great retinue to take a view of it; but, having some thoughts of assuming divine honours, he was destroyed by a tempest from heaven, while yet a day's journey from his paradise. The garden and palace, however, were preserved, though invisible, as a monument of divine vengeance.

After the death of Sheddâd, the kingdom of Ad was governed by a long series of princes, concerning whom many fables are related by the eastern writers. The conclusion of their history, however, is as follows. "The Adites, in process of time falling from the worship of the true God, into idolatry, God sent the prophet Hûd, supposed to be the same with Heber, to preach to and reclaim them. But they refusing to acknowledge his mission or to obey him, God sent an hot and suffocating wind, which blew seven nights and eight days, and, entering at their nostrils, passed thro' their bodies, and destroyed them all, a very few only excepted, who had listened to Hûd, and retired with him to another place." Others relate, "that, before this terrible catastrophe, they had been previously chastised with a three years drought; and therefore sent Kail Ebn Ithar, and Morthed Ebn Sdaa, with 70 other principal men to Mecca, then in the hands of the tribe of Amalek, whose prince was Moawiyah Ebn Becr, to obtain of God some rain. Kail having begged of God that he would send rain to the people of Ad, three clouds appeared, a white, a red, and a black one; and a voice from heaven ordered him to choose which he would. Kail failed not to make choice of the last, thinking it would be laden with most rain; but when this cloud came over them, it proved to be fraught with the Divine vengeance, and a tempest broke forth from it which destroyed them all."

7 Arabs from whom descended.

The *present Arabs*, according to their own historians, are sprung from Kahtan, the same with Joktan, the son of Eber; and Adnan, descended in a direct line from Ishmael the son of Abraham. The former of these they call the *genuine* or *pure* Arabs, and the latter the *naturalized* or *insititious* Arabs.

Joktan the son of Eber had 13 sons, who some time after the confusion of languages settled in Arabia, extending themselves from Mesha to Sephar, a mountainous place in the south-eastern part of that peninsula. According to the Arabian historians, he had 31 sons, all of whom left Arabia and went into India, except two, viz. Yarab and Jorham; the former of whom, they say gave the name both to their country and language. Ishmael and his mother Hagar having been dismissed by Abraham, entered into the wilderness of Paran, as related in the book of Genesis. The sacred historian informs us, that during his residence in the wilderness he married an Egyptian; and the Arabian writers say that he also took to wife the daughter of Modad king Hejaz, lineally descended from Jorham the founder of that kingdom. By the Egyptian he was probably the father of the Scenite or wild Arabs; and having allied himself to the Jorhamites, he is considered by the Arabians as the father of the greatest part of their nation.

Arabia.

8 Joktan the first king.

Kahtan, or Joktan, is said to have first reigned, and worn a diadem in Yaman; but the particulars of his reign we no where learn. He was succeeded by Yarab already mentioned, he by Yashab, and Yashab by Abd Shems. He was successful in his expeditions against his enemies, carried off great spoils, and took many of them prisoners. He is said to have built the city of Saba or Mareb, and above it a stupendous mound or building which formed a vast reservoir, containing all the water that came down from the mountains. By means of this reservoir, the kings of Yaman not only supplied the inhabitants of Saba and their lands with water, but likewise kept the territories they had subdued in greater awe, as by cutting off their communication with it they could at any time greatly distress them.

9 Reservoir of Saba.

Abd Shems was succeeded by his son Hamyar, from whom the tribe of Hamyar is said to take its name; and he by a series of 17 Kings, concerning whom we have no remarkable particular, except that from one of them called *Africus* the continent of Africa took its name. The last of these was succeeded by a daughter surnamed *Balkis* or *Belkis*, whom some will have to be the queen of Sheba who paid a visit to Solomon. After Balkis came Malea, surnamed *Nasherolneam* on account of his magnificence and liberality. Having had bad success in an expedition, where his army was overwhelmed by torrents of sand, he caused a brasen statue to be erected with the following inscription in the old Hamyaritic character. "There is no passage behind me, no moving farther; the son of Sharhabil." He was succeeded by Shamar Yaraash, so called on account of his being affected with a constant tremor. To this prince the city of Sarmacand is said to owe its existence. After Shamar Yaraash we have a list of 15 kings, of whom nothing worth mentioning is recorded, except of one Abu Carb Asaad, who adorned the Caaba or temple of Mecca with tapestry, and first introduced Judaism among the Hamyarites. He was put to death by his subjects, probably on account of religion. The last of the 15 kings above mentioned was called *Abrahah*, who was succeeded by his son Sabban. He had that famous sword called *Samsannah*, which afterwards came into the hands of the khalif Al Rashid. This prince was succeed by Dhu Shanater, who had six fingers on each hand. He was abandoned to unnatural lust, and dethroned for abusing some of the noblest youths in the kingdom. To him succeeded Yusef, who lived about 70 years before Mahomet. He persecuted all those who would not turn Jews, putting them to death by various tortures, the most common of which was throwing them into a glowing pit of fire; whence he had the appellation of the *lord of the pit*. This persecution is taken notice of in the Koran. The last of the Hamyaritic monarchs was Dhu Jadan, according to Abulfeda, but, according to others, the Yusef just mentioned, who was surnamed *Dhu Nowas*, on account of his flowing curls, and was the last who reigned in an uninterrupted succession. He was a bigotted Jew, as already mentioned; and treated his subjects with such barbarity, that they were obliged to ask the assistance of Elesbaas or Elesbaan, king of Ethiopia, against him. Dhu Nowas, not being able to make head against the Ethiopians, was at last driven to such extremity, that he forced his horse into the sea, and lost both his life and crown together.

10 Balkis supposed to be the queen of Sheba.

11 Sarmacand by whom built.

12 Yusef, a bloody persecutor.

13 His subjects call in the king of Ethiopia, who dethrones Yusef.

The

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14 Christian religion established in Arabia.

The king of Ethiopia, having thus become master of Yaman, established there the Christian religion, and fixed upon the throne one Abryat an Ethiopian. He was succeeded by Abraha-Ebn-Al-Sabah, surnamed the *slit-nosed*, from a wound he had formerly received in it. He was likewise styled *lord of the elephant*, from a story too ridiculous to deserve notice. He was succeeded by two other Ethiopian princes; but at last Seif Ebn Dhu Yazan, of the old royal family of Hamyar, having obtained assistance from the king of Persia, which had been denied him by the emperor Heraclius, recovered his throne, and drove out the Ethiopians; but was himself slain by some of them who were left behind. The succeeding princes were appointed by the Persians, till Yaman fell into the hands of Mahomet.

15 Ethiopians driven out.

16 Terrible inundation by the breaking down of the reservoir of Saba.

We have already taken notice of the vast mound or reservoir made by Abd Shems, from which he supplied the city of Saba with water. This building stood like a mountain above the city, and was by the Sabæans esteemed so strong, that they were under no fear of its ever failing. The water rose almost to the height of 20 fathoms; and was kept in on every side by a work so solid, that many of the inhabitants had their houses upon it. About the time of Alexander the Great, however, a terrible inundation happened. According to the Arabian historians, God being displeased at the pride and insolence of the inhabitants of this city, resolved to humble them; and for this purpose sent a mighty flood, which broke down the mound by night whilst the inhabitants were asleep, and carried away the whole city with the neighbouring towns and people. This inundation is styled in the Koran the *inundation of Al-Haram*; and occasioned so terrible a destruction that from thence it became a proverbial saying to express a total dispersion, "that they were gone and scattered like Saba".—By this accident no less than eight tribes were forced to remove their habitations; some of which gave rise to the kingdoms of Hira and Ghassan.

17 Origin, &c. of the kingdom of Hira.

The kingdom of Hira was founded by Malec, a descendant of Cahlan the brother of Hamyar; but after three descents, the throne came by marriage to the Lakhmians, who were descendants of Lakhm the son of Amru, the son of Abd Ems. These princes, whose general name was *Mondar*, preserved their dominion, notwithstanding some small interruption from the Persians, till the khalifat of Abubecr, when Al Mondar Maghrur, the last of them, lost his life and crown by the arms of Khaled-Ebn-Al-Walid. This kingdom continued 622 years and eight months, according to Ahmed Ebn Yusef. Its princes were under the protection of the kings of Persia, and were their lieutenants over the Arabs of Irak, as the kings of Ghassan were for the Roman emperors over those of Syria.

18 Of Ghassan.

The kingdom of Ghassan was founded by the tribe Azd, who, according to some, settling in Syria Damascena, near a water called *Ghassan*, from thence took their name; but others say they went under this appellation before they left Yaman. Having driven out the Dajaamian Arabs, who before possessed the country, they made themselves masters of a considerable territory. Here they maintained themselves, according to some 400, according to others 600, and according to Abulfeda 613 years, when the last of their kings submitted to the khalif Omar, and embraced the Mahometan religion; but receiving afterwards a disgust, soon returned to Christianity, and took refuge in Constantinople.

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19 Of Hejaz.

The kindom of Hejaz was founded by Jorham the son of Kahtan, where princes of his line reigned till the time of Ishmael, who maried the daughter of Modad one of those princes. Some author's relate that Kider, one of Ishmael's sons, had the crown resigned to him by his uncles the Jorhamites: but, according to others, the descendants of Ishmael expelled that tribe; who, retiring to Johainah, were after various adventures destroyed by an inundation. After the expulsion of the Jorhamites, the government of Hejaz seems not to have continued long in the hands of one prince, but to have been divided among the heads of tribes, almost in the same manner as the Arabs of the desart are governed at this day. The tribe of Khozaab, after the above-mentioned inundation of Saba, fled into the kingdom of Hejaz, and settled themselves in a valley called *Marri* near Mecca. Here they founded an aristocracy, assuming to themselves both the government of the city of Mecca, and the custody of the Caaba or temple there. They continued masters of this city and territory, as well as presidents of the Caaba for many ages; till at length one Kosa, of the tribe of Koreish, circumvented Abu Gabshan, a weak and silly man, of whom, while in drunken humour, he bought the keys of the temple for a bottle of wine; but when Abu Gabshan grew cool, and reflected on his imprudence, he sufficiently repented of what he had done; whence the Arabian proverbs, "More vexed with late repentance than Abu Gabshan; more foolish than Abu Gabshan," &c. The tribe of Khozaab endeavoured afterwards to give some disturbance to the Koreish in the possession of the keys of the Caaba, which furnished the latter with a pretence for depriving them of the civil government of Mecca. After the Koreish had possessed themselves of this city, they kept up the same form of government which had prevailed there before. Besides these kingdoms, there were many others of lesser note, of which we find nothing remarkable.

20 Tribe of Khozaab assumes the government of Mecca.

21 Folly of Abu Gabshan

Thus we have briefly mentioned the most memorable events recorded by the Arabian historians previous to the time of Mahomet; but, before entering upon an account of that famous impostor and the kingdom founded by him, it will be proper to take notice of several circumstances in different parts of the world, which at that time concurred to facilitate his scheme, and without which, in all probability, he would never have been able to accomplish it.

22 Cause of Mahomet's success.

The first and great cause of Mahomet's success in his imposture, was the gross corruption and superstition with which the Christian religion was at that time obscured in all parts of the world. Had the pure doctrines of Christianity been then as publicly known as the ridiculous fopperies which deformed the Eastern and Western churches, Mahometanism could never have got a hearing. But along with the true religion, mankind seemed also to have lost the use of their rational faculties, so that they were capable of swallowing the grossest absurdities; such as it now appears almost incredible that any of the human race could receive as truths. Another cause was, the manner of government and way of life among the Arabs. Divided into small independent tribes, they never were capable of a firm union but by superstition; and had

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Mahomet attempted their conquest in any other way, it was impossible he could have succeeded. As there were also among them Jews, Pagans, and Christians of all sorts, this impostor, by adopting something out of every religion then extant, cunningly recommended himself to the professors of every one of them. Add to all this, that, by allowing of polygamy, and setting forth his paradise as consisting in the enjoyment of women, he adapted himself to the corrupt dispositions of mankind in general.

If the distracted state of religion favoured the designs of Mahomet on the one hand, the weakness of the Grecian and Persian Monarchies assisted him no less powerfully on the other. Had those once formidable empires been in their vigour, either of them would have been sufficient to crush Mahometanism in its birth; but both of them were then strangely reduced. The Roman empire had continued to decline after the time of Constantine: the western parts of it were then entirely over-run by the Goths and other barbarous nations; and the eastern, or Greek empire, was so much reduced by the Huns on one hand, and the Persians on the other, as to be incapable of making any great effort. The Persian monarchy itself was in little better condition. It is true, they ravaged the dominions of the Greeks, and often overcame them in the field: but that was more owing to the weakness of the Grecian empire, than to the strength of the Persians; and so effectually did the intestine broils, which arose chiefly on account of religion, weaken the kingdom of Persia, that the most considerable part of it was annexed by the khalif Omar to his dominions.

As the Greeks and Persians were then in a languishing situation, so the Arabs were strong and flourishing. Their country had been peopled at the expence of the Grecian empire; whence the violent proceedings of the different religious sectaries forced many to take refuge in Arabia. The Arabs were not only a populous nation, but unacquainted with the luxuries and delicacies of the Greeks and Persians. They were inured to hardships of all kinds, and consequently much better fitted than their effeminate neighbours to endure the fatigues of war, as the event very fully verified.

23 Mahomet's birth, descent, &c.

Mahomet was born in the year of Christ 569. According to the Eastern historians, he was descended in a direct line from Ishmael. Kedar, or, as the Arabians call him, *Kidâr*, after his father Ishmael's death, communicated his name to the greatest part of Arabia Petræa. He was succeeded in his authority and possessions by his son Hamal; Hamal by Nabet, and Nabet by Salaman. After Salaman came Al Homeisa, then Al Yasa, whose son Odad was succeeded by Odd the father of Adnan. Counting ten generations forward in the same line, we come at last to Fehr, who seems to have distinguished himself by some glorious actions, as he was denominated *Koreish*, on account of his bravery. He is to be considered as the root of the politest and most celebrated tribe of the Arabs. He had three sons, Gâleb, Mohâreb, and Al Aâreth. From Mohâreb the Banu Mohâreb, denominated likewise *Sheibân*, took their origin; from Al Hâreth, the Banu Al Kholoj; and from Gâleb, in a direct line, the impostor Mahomet. Gâleb was the father of Lowa; and he of Caab, whose son Morrah had for his immediate descendant Kelâb the father of Kosa. It was this Kosa who aggrandized

24 Fehr head of the Koreish.

the tribe of the Koreish, by purchasing the keys of the Caaba from Abu Gabshan, as we have already related. By this he not only aggrandized his tribe, but became the prince of it himself. He was succeeded by his second son Abd Menâf, to whom the *prophetic light*, which is said to have manifested itself in his face, gave the right of primogeniture. Abd Menâf was succeeded by his son Amni, surnamed *Hâshem*, or "one that broke bread," on account of his singular generosity during a famine at Mecca. Having amassed great sums of money, he took a journey into Syria, where he purchased a vast quantity of meal, which he made into cakes and divided with his own hands amongst the people of Mecca. He likewise killed a prodigious number of camels, with which he fed them, and relieved them in the time of their distress: and finding that the soil about Mecca was so barren as to produce no fruits but what are common in the desarts, and consequently no corn or grain, which the Meccans are obliged to bring from other places, he appointed two caravans to set out yearly for that purpose, the one in summer, and the other in winter; by means of which, the city was amply supplied with provisions of all kinds. The provisions brought by them were distributed twice a-year; and Hâshem, by his prudent conduct, raised the glory of his people to the highest pitch; insomuch, that all the neighbouring great men and heads of tribes made their court to him. Nay, so great veneration is the memory of Hâshem held in by the Arabs, that from him the family of Mahomet among them are called *Hâshemites*; and he who presides over Mecca and Medina, who must always be of the race of Mahomet, has to this day the title of the "Chief or Prince of the Hâshemites."

25 Hashem's generosity.

Hâshem died at Gaza in Syria, and was succeeded by his son Abdal Motalleb or Mateleb. He is said to have been extremely affable and easy of access, as well as just and generous to a great degree; so that, in the beginning of the month *Ramadan*, he entertained the poor upon the flat roof of his house, and afterwards supplied the fowls of the air and wild beasts of the field with provisions of various kinds, which he ordered his servants to leave upon the summits of the neighbouring mountains. The well which God showed to Hagar in the wilderness is said to have been miraculously discovered to Abdal Motalleb, about 500 years after it had been filled up by Amru prince of the Jorhamites. This well is by the Arabs called *Zemzem*; which some derive from her calling to Ishmael, when she spied it, in the Egyptian tongue, *Zem, Zem*, i. e. Stay, Stay; though others ascribe it to a different origin. The water of this well which is on the east side of the Caaba, and covered with a small building and cupola, is highly reverenced; being not only drank with particular devotion by the pilgrims, but also sent in bottles as a great rarity to most parts of the Mahometan dominions.

26 Well Zemzem discovered by Abdal Motalleb.

Abdalla, the father of the Mahomet, was a younger son of Abdal Motalleb, and remarkable for his beauty. In his 24th or 25th year, he married Amina, the daughter of Wâheb, the son of Abdal Menâf. She is represented as the most beautiful, prudent, and virtuous lady of her tribe; and consequently the most worthy of such an extraordinary person as Abdalla. He died young, and, in his father's life-time, left his widow

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an infant son in very mean circumstances; his whole substance consisting only of five camels and one female Ethiopian slave. Abdal Motalleb was, therefore, obliged to take care of his grandson Mahomet; which he not only did during his life, but at his death enjoined his eldest son Abu Taleb to provide for him for the future. Abu Taleb was extremely kind to his nephew, and instructed him in the business of merchandise; for which purpose he took him into Syria when he was but 13 years of age, recommending him to Khadijah, a noble and rich widow, for her factor; in whose service he behaved so well, that she married him, and thus raised him to an equality with the richest in Mecca.

27 Mahomet at first a merchant.

28 Begins to broach his doctrine.

Though Mahomet had probably formed a design of introducing his new religion pretty early, he did not think proper to avow it till the 40th year of his age. The grand article of his faith was, the unity of the divine nature, which he pretended was violated by the Jews and Christians no less than by the Pagans; for which reason, he resolved to make an attempt to rescue the world from the ignorance and superstition which prevailed at that time. This reformation he intended should begin in his own family; and therefore, having retired with his household to a cave in Mount Hara, near Mecca, he there opened the secret of his mission to Khadijah; acquainting her that the angel Gabriel had just appeared to him, and told him that he was appointed the Apostle of God. He also repeated to her a passage which he said had been revealed to him by the ministry of the angel, with an account of many prodigies which happened at his birth (See MAHOMET). This pretended revelation was received by Khadijah with the greatest joy; and in a kind of ecstasy she immediately communicated the good news to her cousin Waraka Ebn Nawfal, who, being a Christian, could write in the Hebrew character, and was pretty well versed in the Scriptures both of the Old and New Testament. He very readily came into her opinion, swore by God that what she said was true," and that "Mahomet was the great prophet foretold in the law by Moses the son of Amram."

29 Converts his wife and cousin, &c.

Mahomet finding his first step so successful, as Waraka was a very considerable person, began to entertain great hopes of accomplishing his design. He next converted his servant Zeid, to whom he gave his liberty on the occasion, which afterwards became a rule to his followers; and then Ali the son of Abu Taleb, though at that time only nine or ten years of age. This last, however, making no account of the other two, he used to call *the first of believers*. The next person he applied to was Abu Becr, a man of very considerable authority among the Koreish. He was easily gained over, and by his influence several others; so that Mahomet now made his mission no longer a secret. To Abu Becr he gave the name of *Al Saddik*, or *the faithful witness*; because he not only vouched for every thing he said, but also greatly increased the number of his followers. Mahomet likewise complimented him with the title of *Atik*, or *preserved*; intimating thereby that he was certainly saved from hell-fire.

Having given out that he was commanded from heaven to admonish his near relations, Mahomet directed Ali to prepare an entertainment, and invite to it the sons and descendants of Abdal Motalleb. He intended to open his mind to them; but Abu Laheb, one of Mahomet's uncles, making the company break up before the prophet had an opportunity of speaking to them, he was obliged to invite them again the next day. Having now proposed the matter, he asked which of them would become his wazir, prime minister, or vicegerent. This was accepted by Ali; upon which Mahomet said to him, "This is my brother, my deputy, and my *(khalif)* successor, or vicar; therefore show yourselves submissive and obedient to him." At this speech all the company fell a-laughing, telling Abu Taleb that he must now pay obedience and submission to his own son. Notwithstanding this repulse, however, Mahomet was so far from being discouraged, that he began to preach to the people in public. They heard him with some patience till he began to upbraid them with the idolatry, obstinacy, and perverseness of themselves and their fathers; which so highly provoked them, that they openly declared themselves his enemies, except some few who were converted. The prophet was now protected by the authority of his uncle Abu Taleb; who, however, was earnestly solicited to persuade his nephew to desist, and at last threatened with an open rupture in case he could not prevail on him so to do. This had such an effect upon Abu Taleb, that he advised his nephew not to push the matter any farther; representing the great danger he and his followers would otherwise run: but our prophet was not to be so intimidated; and told his uncle plainly, that "if they set against him the sun on his right hand, and the moon on his left, he would not abandon his enterprize." Abu Taleb, therefore, finding him so firmly resolved, used no further arguments, but promised to stand by him to the utmost of his power: so that notwithstanding the people of his tribe came to a determination to expel both Mahomet and his followers, he found a powerful support in his uncle against all their machinations.

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30 Rejected by the Koreish.

31 His resolution.

Mahomet now entered upon his apostolic function with uncommon diligence and application; and soon gained over his uncle Hamza, and Omar Ebn Al Khattah, a person very much esteemed, and who before had been his violent opposer. Notwithstanding this success, however, the Koreish continued their opposition, and came to a resolution to proscribe all who had embraced Mahomet's doctrine. In consequence of this resolution, the *Moslems*, as his followers were called, were now treated with such severity, that they found it no longer safe to continue in Mecca; nay, several of them in the fifth year of his mission found themselves obliged to fly into Ethiopia, where they were kindly received by the Najashi or king of that country, who refused to deliver them up to those whom the Koreish sent to demand them. At this refusal they were so exasperated, that they came to a resolution to suppress effectually the new religion which had now made a considerable progress. In order to this, they entered into a solemn league or covenant against the Hashemites, and the family of Abdal Motalleb in particular, engaging themselves to contract no marriages with them, nor to have any manner of communication with them otherwise; and, to give this the greater weight, they reduced it into writing, and laid it up in the Caaba. Upon this the tribe became divided into two factions; and all the family of Hashem, both Mos-

32 His followers persecuted.

33 The Koreish enter into a league against him

lems and unbelievers, repaired to Abu Taleb as their head; except only Abdal Uzza, ſurnamed Abu Laheb, the ſon of Abdal Motalleb, who, out of hatred to his nephew and his doctrine, went over to the oppoſite party. After this the authority of Abu Taleb was ſcarce ſufficient to protect Mahomet from the fury of the Koreiſh; who, according to Al Jannabi, made frequent attempts upon him; ſometimes endeavouring to deſtroy him by force, at other times by ſecret wiles and machinations: nay, to compaſs their end, he tells us that they had recourſe to magic, inchantments, and diabolical illuſions. In ſhort, they gave him at laſt ſo much trouble, that he was obliged to change his habitation, and ſeek a new aſylum for himſelf and his companions. This he found in the houſe of one Orkam, which was advantageouſly ſituated on a hill called *Safa*. Here he converted Orkam's family, and the houſe was afterwards held in high eſtimation by the Moſlems.

34 Their writing deſtroyed by a worm.

The two factions into which the tribe of Koreiſh was divided ſubſiſted for five years, when they were put an end to by a very ſtrange accident. Mahomet told his uncle Abu Taleb, that God had manifeſtly ſhowed his diſapprobation of the covenant entered into againſt them, by ſending a worm to eat out every word of the inſtrument except the name of God. With this particular Abu Taleb immediately acquainted the Koreiſh; offering, in caſe it proved falſe, to deliver up his nephew to them; but if it ſhould prove true, he inſiſted that they ought to lay aſide their animoſity, and annul the league they had made againſt the Haſhemites. To this they acquieſced; and going to inſpect the writing, found it to be as Abu Taleb had told them; the words "In thy name, O God," being the only ones which remained. On ſo remarkable a proof of the divine diſpleaſure, the league was immediately annulled, and all acts of hoſtility between the two parties ceaſed.

After this memorable event Mahomet remained with his uncle Abu Taleb, who ſurvived the reconciliation only about eight months. The ſame year alſo died Khadijah, Mahomet's wife. Her death, as well as that of his uncle, proved a great detriment to his affairs;

35 Mahomet ſtill perſecuted by the Koreiſh.

for the Koreiſh, notwithſtanding the former reconciliation, began now to proſecute him with more violence than ever. He was therefore obliged to fly for ſhelter to Al Tayef; which he choſe on account of its being the reſidence of his uncle Al Abbas, whoſe protection he imagined he would be able to ſecure. In this, however, he found himſelf miſtaken; and though he ſtaid a month in the city, during which time he gained over a few, yet at laſt the lower ſort of people roſe againſt him and obliged him to return to Mecca. This refuſal, though it greatly diſcouraged the new converts, did not in the leaſt abate the zeal of Mahomet: on the contrary, he continued to preach boldly to the public aſſemblies at the pilgrimage to Mecca, exclaiming againſt idolatry, and particularly againſt the worſhip of two idols Allat and Al Uzza, to which the tribes, eſpecially the women of that of Thakif, were very much addicted. By this the prophet was often expoſed to great danger: however, he gained ſome converts, and amongſt them ſix of the inhabitants of Yathreb, of the Jewiſh tribe of Khazraj; who, on their return home, failed not to ſpeak much in commendation of their new religion, and exhorted their fellow-citizens immediately to embrace it. Theſe converts of the tribe of Khazraj are by the Arab writers called *Al Anſar*, *Al Anſarii*, or *Anſars*; that is, aſſiſtants, favourers, ſupporters, &c. because they aſſiſted and ſupported the prophet when he was purſued to the very brink of deſtruction.

36 Anſars, who.

They firſt met mahomet on a little hill called *Al Akabah*, where a temple ſtood, and where they firſt took an oath to exert themſelves in ſupport of their new apoſtle and his religion. An uninterrupted friendſhip and harmony reigned for a long time amongſt the members of the Jewiſh tribes of Khazraj, Koreidha, and Nadir, whoſe great progenitor, ſay the Arabs, was Aaron the ſon of Amran. Mahomet therefore inſinuating himſelf into the good graces of the Anſars, they readily embraced his religion, and proved of very conſiderable ſervice.

37 Mahomet's journey to heaven.

The next remarkable thing recorded of Mahomet is the invention of his night-journey to heaven. This he probably intended to ſupply the place of miracles. The abſurdities contained in that relation, however, are ſo great, that when he related it to his uncle Al Abbas, and Omm Hana the daughter of Abu Taleb, they endeavoured to diſſuade him from making it public. This advice he was ſo far from following, that he related the whole to Abu Jahl, one of his moſt inveterate enemies, who ridiculed him for it, and placed the ſtory in ſuch a ridiculous light to the Koreiſh, that they were on the point of inſulting him; ſeveral of his

38 Almoſt proves the ruin of his cauſe.

followers alſo left him; and the whole deſign had probably been ruined, had not Abu Becr vouched for his veracity, and declared, that, if Mahomet affirmed it to be true, he firmly belived the whole. This declaration not only retrieved the prophet's credit, but increaſed it to ſuch a degree, that he was ſure of making his diſciples ſwallow whatever he pleaſed; and on this occaſion it is ſaid by ſome that he gave Abu Becr the name of the *faithful witneſs*; as we have already related.

In the twelfth year of Mahomet's miſſion, twelve men of Yathreb, or Medina, of whom ten were of the tribe of Kharai, and two of that of Aws, came to Mecca, and took an oath of fidelity to the prophet at the hill Al Akaba. When they had ſolemnly engaged to do all required of them, Mahomet ſent one of his diſciples, named *Maſab Ebn Omair*, home with them, to inſtruct them more fully in the grounds of their new religion. Maſab being arrived at Medina, with the aſſiſtance of the new proſelytes, gained ſeveral others; and acquainting Mahomet with the ſucceſs of his miſſion, deſired leave to form a congregation of

39 Congregation of Moſlems formed at Medina.

Moſlems at Medina. This the prophet readily granted; in conſequence of which, the new Moſlems regularly aſſembled, to the number of forty perſons, in the houſe of Saad Ebn Khaithama. The next year Maſab returned to Mecca, accompained by ſeventy-three men and two women of Medina, who had profeſſed Mahometaniſm, beſides ſeveral others who were yet unbelievers. On their arrival they ſent immediately to Mahomet, and offered him their aſſiſtance, of which he now ſtood in the greateſt need; for his adverſaries were by this time grown ſo powerful in Mecca, that he could not ſtay there much longer without imminent danger. He therefore accepted their propoſal, and met them one night by appointment at the hill Al Akaba. At this interview he was attended by his uncle

Al Abbas; who, though then an unbeliever, wished his nephew well, and made a speech to the people of Medina; wherein he told them, that as Mahomet was obliged to quit his native city and seek an asylum elsewhere, and as they had offered him their protection, they would do well not to deceive him; and if they were not firmly resolved to defend, and not to betray him, they had better declare their minds, and let him seek for protection somewhere else. Upon their protesting their sincerity, Mahomet swore to be faithful to them, a part of the Koran being read to all present, on condition they should protect him against all insults, as heartily as they would do their own wives and families. They then asked him what recompence they were to expect if they should happen to be killed in his quarrel: he answered, Paradise; upon which they pledged their faith to him, after Mahomet had chosen twelve out of their number, who were to have the same authority under him that the twelve apostles had under Christ.

Finding now a confederacy formed in his favour, our prophet began to pull off the mask as to his true sentiments concerning the means of reformation. Hitherto he had propagated his religion by fair means only; and in several passages of the Koran, which he pretended were revealed before this time, he declared, that his business was only to preach and admonish; that he had no authority to compel any person; and that whether they believed or not, was none of his concern, but belonged solely to God. But no sooner did he find himself enabled, by the alliance abovementioned, to resist his enemies, than he gave out that God had allowed him and his followers to defend themselves; and at length, as his forces increased, he pretended not only to have leave to act on the defensive, but to attack the infidels, destroy idolatry, and set up the true religion by the power of the sword. To this he was excited by an apprehension that pacific measures would greatly retard, if not entirely overthrow, his designs; and therefore he determined to use the most violent methods to convert the Pagan Arabs, or rather to extend his own authority.

40
The Koreish resolve to put Mahomet to death.

The Koreish, in the mean time, finding that Mahomet had considerably extended his influence, and hearing of the league concluded with the Ansars, began to think it absolutely necessary that he should be prevented from escaping to Medina; and, in order to do this the more effectually, they resolved in a council, wherein it is said the devil assisted in person, to put an end to his life. To accomplish this with the greater safety, they agreed that a man should be chosen out of every tribe, and that each should have a blow at him; that so the guilt of his death might fall equally on all the tribes, and thus the Hashemites would be prevented from attempting to revenge the death of their kinsman, as they were much inferior in power to the rest of the tribes put together. Mahomet now directed his companions to repair to Medina, where, in consequence of the late treaty, they might be assured of protection. This they accordingly did: but he himself, with Abu Becr and Ali, remained behind; not having received, as he pretended, the divine permission to retire. Here he narrowly watched the motions of the Koreish, and was soon apprised of their machinations: for the abovementioned conspiracy was scarce formed, when by some means or other it came to Mahomet's knowledge; and he gave out that it was revealed to him by the angel Gabriel, who also commanded him to retire from Mecca. The conspirators were already assembled at the prophet's door; but he, to amuse them, ordered Ali to lie down in his place, and wrap himself in his green cloak: this Ali complied with, and Mahomet miraculously, according to the Arabs, escaped to the house of Abu Becr. The conspirators, in the mean time, perceiving through a crevice Ali wrapped up in the green cloak, took him for Mahomet himself, and watched there till morning, when Ali arose, and they found themselves deceived.

41
He outwits them and escapes.

42
In great danger at mount Thur.

The prophet next retired in company with Abu Becr to a cave in mount Thur, an hill a little south of Mecca. Here he had still a more narrow escape; concerning which we have the following account from an Arabic tradition. "The Koreish having detached a party from Mecca to reconnoitre the mouth of the cave, when they came there, found it covered by a spider's web, and a nest built at the entrance by two pigeons which they saw, and which had laid two eggs therein. On sight of this they reasoned with themselves in the following manner: "If any person had lately entered this cavern, "the eggs now before us would infallibly have been "broke, and the spider's webb demolished; there can "therefore be no body in it;" after which, they immediately retired. As the prophet, therefore, and his friend, were now saved so miraculously by means of the pigeon's eggs and the interposition of the spider's web, he afterwards enjoined his followers, in memory of so remarkable an event, to look upon pigeons as a kind of sacred animals, and never to kill a spider."

43
He is pursued and overtaken, but still escapes.

The prophet and Abu Becr having staid in this cave three days in order to recover a little from their consternation, set out for Medina; but the Koreish, being informed of the route they had taken, sent a party after them, under the command of Soraka Ebn Malec. These overtook them; and, as the Arab historians tell us, Soraka's horse fell down when he attempted to seize Mahomet. Upon this he recommended himself to the prophet's prayers, and remounted his horse without hurt: but, as he still continued the pursuit, his horse fell down with him a second time; upon which he returned to Mecca, without offering any farther violence: and Mahomet, thus happily delivered from the greatest dangers, arrived without farther molestation at Medina, where he was received with the greatest demonstrations of joy.—This flight of the prophet from Mecca to Medina was reckoned so remarkable by the Moslems, that they made it the æra from whence all their remarkable transactions were dated, called it the *Æra of the Hegira*, or *flight*. The beginning of the Hegira corresponded with the 16th of July, A. D. 622.

44
Æra of the Hegira.

On Mahomet's arrival at Medina, his first care was to build a mosque for his religious worship, and an house for himself. The city of Medina at that time was inhabited partly by Jews and partly by heretical Christians, that formed two factions which persecuted one another with great violence. This gave the impostor such an opportunity of propagating his new religion, that in a short time the city was entirely at his devotion. Here he strengthened himself by marrying Ayesha the daughter of Abu Becr, though then only seven years of age, and gave his own daughter Fatima in marriage to Ali,

 the

Arabia.

45 Union of the Ansars and Mohajerin.

the son of Abu Taleb. The next point he had in view was the union of the Mohajerin, or those who fled from Mecca on account of their religion, with the Ansars above mentioned. To facilitate this, after the mosque and house were finished, he established among the Moslems, a fraternity, the principal statute of which was, that they should not only treat one another like brethren, but likewise most cordially love, and mutually cherish, one another to the utmost of their power. But, lest even this should prove insufficient, he coupled the individuals of the two bodies of Ansars and Mohajerin; and this was the last transaction of the first year of the Hegira.

The next year was ushered in, according to Abulfeda, with a change of the *Kebla*, or place whither the Mahometans were to turn their faces in prayer. At first it had been declared to be perfectly indifferent where they turned their faces. Afterwards he directed them to pray with their faces towards the temple of Jerusalem, probably with a view to ingratiate himself with the Jews; and, now in order to gain the Pagan Arabs, he ordered his followers to pray with their faces towards the east. This inconstancy gave great offence, and occasioned the apostacy of many of his disciples. About this time Mahomet receiving advice that a rich caravan of the Koreish was on the road from Syria to Mecca, he detached his uncle Hamza, at the head of 30 horse, to seize upon it; who accordingly lay in wait for it in one of the woods of Yamama, thro' which it was to pass: here, however, he was informed that the caravan was guarded by 300 men, so that he returned without making any attempt; but the prophet made the proper dispositions for acting hereafter against the Koreish with success. This year also Mahomet sent out a party of 60 or 80 horse, all Mohajerin, except one who was an Ansar, to make reprisals on the the Koreish. They were met by a party of their enemies, and both sides immediately prepared for an engagement: however, they parted without bloodshed, except one of the Koreish, who was killed by an arrow shot by one of the Moslems.

46 Mahomet takes a caravan, and gains the battle of Bedr.

Mahomet, having now put himself into an offensive posture, began in earnest to make reprisals on the Koreish. His first exploit was the taking of a caravan attended by a small guard; and this being accomplished by a party consisting only of nine men, contributed greatly to encourage the Moslems. But what most established the impostor's affairs, and was indeed the true foundation of all his future greatness, was his gaining the battle of *Bedr;* of which we have the following account.——The prophet being informed that Abu Sofian Ebn Harb escorted a caravan of the Koreish with only 30 or 40 men, resolved to advance at the head of a small detachment of his troops to intercept it. To this he was excited by the riches of the caravan, which consisted of a large quantity of merchandize, consisting of the riches of Syria, carried on the backs of a thousand camels. He therefore sent out a party to reconnoitre it, with orders to wait in some convenient place, where they might remain undiscovered. But Abu Sofian having notice of Mahomet's motions, dispatched a courier to Mecca, requesting succours from his countrymen, that he might be able to defend the caravan. Upon this Mahomet drew together all his forces, which amounted to no more than 313, while his enemies consisted of very near 1000, Abu Sofian having been reinforced by the Meccans with 950 men. The two armies did not long remain in a state of inaction: but before the battle three champions from each party engaged each other in single combat. In this the Moslem champions were victorious, and the event greatly discouraged the Koreish. Mahomet, in the mean time, taking advantage of this lucky event, offered up his prayers to God with great fervency and vehemence; after which, feigning himself in a trance, he pretended that God had assured him of victory. Then throwing an handful of dust or gravel towards the enemy, he cried out, "May the faces of them be confounded;" and attacked the Koreish with such bravery, that they were soon put to flight, leaving 70 dead on the spot, and having as many taken prisoners. The loss on Mahomet's side was only 14 men, and among the prisoners was Al Abbas the prophet's uncle.

Though this action may seem of little consequence in itself, it was of very great advantage to Mahomet's affairs at that time. He was immediately treated with the highest respect by the Najashi, or King of Ethiopia, who received a particular account of the victory soon after it was gained; while the superstitious Moslems did not fail to look upon it as an evident declaration of heaven in their favour. Nay, notwithstanding the small number of enemies to be overcome, and who were only mortal men, these ignorant bigots did not hesitate to own the assistance of no less than 4000 angels, who, according to them, rode on black and white horses, having on their heads white and yellow sashes, that hung down between their shoulders!

Notwithstanding their disaster, however, Abu Sofian made a pretty good retreat, and conducted the greatest part of the caravan to Mecca. This chagrined the Moslems, though they found great spoil on the field of battle; the division of which had likely to have proved fatal to their cause, by the quarrels that it occasioned among them. So hot, indeed, were the disputes on this occasion, that the impostor was obliged to pretend an immediate revelation from heaven, empowering him to retain a fifth part for religious purposes, and to distribute the rest equally. This became a law for his successors; but, with regard to himself, the prophet often took the liberty of infringing it; for which, no doubt, a new revelation was always a ready and convenient salvo. As for those who were slain on Mahomet's part in this battle, they were all looked upon by the Moslems as martyrs; and the prophet perceiving among the prisoners two of his inveterate enemies, immediately caused their heads to be struck off.

47 His law concerning the division of spoils.

The Koreish, in order to be revenged on Mahomet for their late defeat at Bedr, sent Amru Ebn Al As, who afterwards conquered Egypt, with some other of their principal people, on an embassy to the king of Ethiopia, in order to interest him in their quarrel. To do this the more effectually, they accused Mahomet and his followers of speaking disrespectfully of JESUS and of his mother MARY; which accusation they hoped would likewise induce him to deliver up the Moslem refugees that were then at his court. But the bad success that had attended the arms of the Koreish hitherto, joined to the excuses made by the refugees, not only hindered the Najashi from delivering them up, but

but also prompted him to dismiss the ambassadors, and return the presents they had brought him. In the mean time, Abu Sofian, who had sworn never to use perfumes or enjoy women till he had another battle with Mahomet, set out from Mecca with a body of 200 horse. He advanced to a post within three miles of Medina; from whence he sent a detachment, who burnt a barn, together with a man in it that was winnowing wheat. Mahomet, being informed of this outrage, moved immediately towards him with a detachment of cavalry; but Abu Sofian was so intimidated by his approach, that he fled with precipitation, leaving behind him all the sacks of flour or meal that had been brought for the subsistence of his troops. Instead therefore of coming to an engagement with the impostor, as he had sworn, he contented himself with alarming the country, and pillaging such as he suspected of favouring Mahometanism. This year also Mahomet conquered the tribes called *Banu Solaim, Ghatfan*, and the *Banu Kainoka*; plundering likewise a rich caravan belonging to the Koreish, and acquiring from thence 25,000 dirhems for his own share of the plunder.

48 Abu Sofian's cowardice.

In the year of Christ 625, being the third of the Hegira, the Koreish assembled an army of 3000 men, among whom were 200 horse and 700 armed with coats of mail. The command of this army was given to Abu Sofian, who was attended by his wife Henda Bint Otba, and sat down at a village about six miles distant from Medina. Mahomet, being much inferior to the enemy, resolved at first to keep himself within the town, and receive them there; but afterwards, by the advice of his companions marched out against them at the head of 1000 according to some, 1050 according to others, or, as some say, only 900 men. Of these 200 were cuirassiers; but he had only one horse besides his own in the whole army. He distributed three standards among his troops; of which one was given to the tribe of Aws, another to that of Khazraj, and the third to Mohajerin. The grand standard was carried before the prophet by Mosaab Ebn Omair. With these forces Mahomet formed a camp in a village near Ohod, a mountain about four miles north of Medina, which he contrived to have on his back; and the better to secure his men from being surrounded, he placed 50 archers, the flower of his troops, in the rear, with strict orders not to quit their post. On the other hand, the army of the Koreish was drawn up in the form of a crescent, and made a very good appearance. The right wing was commanded by Khaled Ebn Al Walid, afterwards so terrible to the Greeks, the left by Acrema Ebn Abu Jahl; and the centre by Abu Sofian. The corps de reserve was headed by Abu Sofian's wife, accompanied by 15 other matrons, who performed the office of drummers, lamenting the fate of their countrymen slain at Bedr, in order to animate the troops who attended them. The attack was begun by the Moslems, who fell upon the enemy with such fury, that their centre immediately began to give away. Ali, or, according to Abulfeda, Hamza, slew Arta the enemy's great standard-bearer; which struck them with such terror, that they soon betook themselves to flight, falling foul upon their own corps de reserve. Victory had now been no longer doubtful, notwithstanding the vast inferiority of Mahomets troops, had not the 50 archers, contrary to the prophet's express command, quitted their post to pillage the enemy. Upon this Khaled, perceiving the Moslem army to be greatly exposed, attacked them in the rear with such bravery, that he turned the fortune of the day. Not content with putting the troops there in disorder, he cried out with all his might, "Mahomet is slain; and this had such an effect upon the Moslems, that they immediately took to their heels, nor could the utmost endeavours of the prophet himself afterwards rally them. He therefore found himself obliged to quit the field of battle; in doing which he was very near losing his life, being struck down by a shower of stones, and wounded in the face by two arrows, which occasioned the loss of two of his fore-teeth. He likewise received a contusion on his upper lip; and had even been killed on the spot, had not one of his companions, named *Telha*, Abu Becr's nephew, received a blow that was levelled at him. On this occasion Telha received a wound in his hand, which deprived him ever after of the use of some of his fingers. Of the Moslems 70 were slain; among whom were Hamza the prophet's uncle, and Mosaab the standard-bearer. Amongst the wounded were Abu Becr, Omar, and Othman; but as soon as they understood that the prophet was safe, they returned to the charge with a considerable body, and, after an obstinate dispute, carried him off. The good retreat made by these champions so discouraged the troops of Abu Sofian, that they did not pursue the flying enemy, but contented themselves with remaining masters of the field of battle; nor did that general, tho' he exulted not a little in his victory, make any farther use of it than to give Mahomet a challenge to meet him the next year at Bedr, which was accepted; and after his return to Mecca, he desired a truce with the Moslems, which was readily granted.

49 Battle of Ohod.

50 Mahomet defeated.

51 He apologizes for his defeat.

This defeat had like to have proved the total ruin of the impostor's affairs, and must inevitably have done so had the conquerors made the least use of their victory. Some of his followers now asserted, that had he been really a prophet sent from God, he could not have been thus defeated; and others were exasperated on account of the loss of their friends and relations who had been slain in the late engagement. To still the murmurs of the former, he laid the blame on the sins of those who had accompanied him; and, to pacify the latter, he pretended a revelation from heaven, wherein the period of all mens lives was said to be unalterably fixed without regard to their own actions, or to any external objects; so that those who were killed in battle behoved to have died, though they had remained at home in their own houses. By the assistance of this last doctrine he encouraged his followers to fight, without fear, for the propagation of their faith, as all their caution would not be sufficient to avert their destiny, or prolong their lives even for a single moment.

The next year, (A. D. 626), Mahomet, besides several other less considerable successes, reduced a fortress belonging to the Jewish tribe of Al Nadir, who had revolted on account of the defeat at Ohod: on this occasion, by an express revelation, as he pretended, he kept the whole booty to himself; and, about the same time, forbad his followers the use of wine, or to play at games of chance, on account of the disturbances and

quarrels

Arabia.

quarrels which were likely to be excited by that means among them. This year also he marched with a body of infantry to Bedr, to meet Abu Sofian, as he had promised the year before: but that general's heart failing him, he returned home without facing the prophet; and this piece of cowardice the Moslems did not fail to impute to a terror sent immediately from God. The year following, however, the Koreish, in conjunction with the tribe of Ghatfan, and the Jews of Al Nadir and Koreidha, assembled an army of 12,000 men, with which they formed the siege of Medina, thus threatening the impostor and all his followers with utter destruction at once. On the enemy's approach, Mahomet, by the advice of a Persian named *Salman*, ordered a deep ditch to be dug round the city, and went out to defend it with 3000 men. The Arabs having invested the town, both sides remained in a state of inactivity for some time; which was so well employed by the impostor, that he found means to corrupt some of the leading men in the enemy's camp. The good effects of this soon appeared; for a champion having advanced to the Moslem entrenchments, and challenged the best man in their army to fight him in single combat, the challenge was immediately accepted by Ali, who slew him and another that came to his assistance; after which, those who had been corrupted by Mahomet's agents so soured a considerable part of the forces, that they deserted their camp; upon which all the rest were obliged to raise the siege and return home.

52 Siege of Medina.

53 The siege raised.

The prophet, being now happily delivered from the most powerful combination that had ever been formed against him, was visited by the angel Gabriel; who asked him, whether he had suffered his men to lay down their arms, when the angels had not laid down theirs? ordering him at the same time to go immediately against the tribe of Koreidha, and assuring him that he himself would lead the way. Upon this Mahomet immediately set out for the fortress of the Koreidhites, and pushed on the siege with so much vigour, that, tho' it was deemed impregnable, he obliged the garrison to capitulate in twenty-five days. The Koreidhites, not daring to trust themselves to the impostor's mercy, surrendered at discretion to Saad Ebn Moadh, prince of the tribe of Aws, hoping that he, being one of their old friends and confederates, would have some regard for them. Here, however, they found themselves disappointed; for Saad, being highly provoked at them for assisting the Koreish while in league with Mahomet, ordered the men to put to the sword, the women and children made slaves, and their goods divided among the Moslems. This sentence was no sooner heard by Mahomet, than he cried out that Saad had pronounced the sentence of God; and, in consequence of this decision, ordered the men, to the number of 600 or 700, to be immediately massacred. The women and children were also carried into captivity. Their immoveable possessions were given to the Mohajerin, and the goods divided equally.

54 Khoreidhites massacred.

Mahomet now continued to be successful, gradually reducing the Arab tribes one after another. In 628, he sent an agent to Constantinople, desiring leave of the Greek emperor to trade with his subjects; which was immediately granted. The same year also he concluded a peace for ten years with the inhabitants of Mecca, and obtained liberty the next year to perform his devotions at the Caaba. What tended considerably to bring about this pacification was an account brought to the Koreish by one whom they had sent with an actual defiance to Mahomet, of the prodigious veneration which his followers had for him. This messenger acquainted them that he had been at the courts both of the Roman emperors and of the kings of Persia, but never saw any prince so highly respected as Mahomet was by his companions. Whenever he made the ablution in order to say his prayers, they ran and caught the water which he had used; whenever he spit, they licked it up, and gathered up every hair that fell from him, with great veneration. This intimated how desperately they would fight in his defence, and probably inclined his enemies to avoid hostilities. In 629, the impostor began to think of propagating his religion beyond the bounds of Arabia, and sent messengers to several neighbouring princes to invite them to embrace Mahometanism; but, before sending the letters, he caused a silver seal to be made, on which were engraved in three lines the following words, "MAHOMET THE APOSTLE OF GOD." This seal, he believed, would procure the letters to which it was affixed a more favourable reception at the courts of those princes whither they were directed. The first to whom he applied was Khosru Parviz the king of Persia; but he, finding that Mahomet had put his own name before his, tore the letter in pieces, and sent away the messenger very abruptly. He also sent a letter to the same purpose to Constantinople; but though the emperor Heraclius dismissed his messengers honourably, he refused to abandon the Christian faith. Besides these, he wrote five other letters, which he distributed among those who he thought would be most likely to acknowledge him for an apostle. However, we do not hear that by means of letters he ever introduced his religion into a foreign country.— But while our impostor was thus going on in the full career of success, and industriously propagating his infamous falsehoods by all the means he could think of, he was poisoned by a maid, who wanted, as she said, to make an experiment whether he was a prophet or not. This was done by communicating some poison to a shoulder of mutton, of which one of his companions named *Bashar Ebn Al Bara*, eating heartily, died upon the spot; and Mahomet himself, though he recovered a little, and lived three years after, yet never enjoyed perfect health. Notwithstanding this misfortune, however, he still continued his enterprizes. The year 630, proved remarkably fortunate. It was ushered in by the conversion of Khalid Ebn Al Walid, Amru Ebn Al As, and Othman Ebn Telha, three of the most considerable persons among the Koreish; and this soon enabled him to become master of the whole peninsula of Arabia. This year also the inhabitants of Mecca took it into their heads to violate the treaty concluded with Mahomet: for the tribe Becr, who were the confederates of the Koreish, attacking those of Khozaab, who were in alliance with Mahomet, massacred 20 of them, and afterwards retired; being supported in this action by a party of the Koreish themselves.— The consequence of this violation was soon apprehended; and Abu Sofian himself made a journey to Medina, in order to heal the breach and renew the truce: but in vain; for Mahomet, glad of this opportunity, refused to see him. Upon this he applied to Abu Becr, Ali, Omar,

Arabia.

55 Prodigious veneration for Mahomet.

56 He invites foreign princes to embrace his religion.

57 Is poisoned, but recovers.

58 Meccans violate the treaty with Mahomet.

Arabia. Omar, and Fatima, to intercede for their countrymen with the prophet; but some of these giving him rough answers, and others none at all, he was obliged to return to Mecca as he came. Mahomet immediately gave orders for the necessary preparations, that he might surprise the Meccans, who were by no means in a condition to receive him; but Hateb Ebn Abu Baltaa, hitherto a faithful Moslem, attempted to give them notice of their danger by a letter, though without effect. His letter was intercepted: and he alleged in his excuse, that the only reason he had for his conduct was to induce the Koreish to treat his family with kindness. This excuse the prophet accepted, as he had greatly distinguished himself at the battle of Bedr, but strictly forbade any such practices for the future; which having done, he immediately made the necessary dispositions for setting forward.

Mahomet's army, on this occasion, was composed of Mohajerin, Ansars, and other Arabs, who had lately become proselytes. As they drew near to Mecca, he set up his standards, and advanced in order of battle to Mar Al Dharan, a place about four parasangs from Mecca, where the whole army encamped. Here he ordered 10,000 fires to be lighted, and committed the defence of the camp to Omar, who cut off all communication with the town, so that the Meccans could receive no certain advice of their approach. Among others that came from Mecca to reconnoitre the Moslem camp, Abu Sofian Ebn Harb, Hakim Ebn Hezam, and Bodail Ebn Warka, fell into Omar's hands; and being conducted to Mahomet, were obliged to embrace Mahometanism in order to save their lives.

The first rumour of this expedition had not a little terrified the Koreish, though they were not apprized that the prophet had resolved upon a war: but perceiving now, upon the report of Abu Sofian, who had been sent back to them, that the enemy was at their gates, they were thrown into the utmost consternation. Of this Mahomet being informed, he resolved to take advantage of the confusion that then reigned among them. He therefore first dispatched Hakem and Bodail to the Meccans, inviting them to take an oath of allegiance to to him, and become converts to his new religion; after which, he made the following disposition of his forces. Al Zobier was ordered to advance with a detachment towards the town on the side of mount Cada. Saad Ebn Obad, prince of the tribe Khazraj, marched by his order with another detachment towards the height of Coda, which commands the plain of Mecca. Ali commanded the left wing of the army, consisting of Ansars and Mohajerin. The prophet put into his hands the great standard of Mahometanism, with orders to post himself upon mount Al Hajun, and to plant the standard there; strictly enjoining him, however, not to stir from thence till he himself arrived, and till a proper signal should be given him from Saad for that purpose. Khaled led the right wing, consisting of the Arabs lately converted, with which he was to possess himself of the plain of Mecca. Abu Obeidah commanded in the centre, which consisted entirely of infantry: the prophet himself remained in the rear, from whence he could most easily dispatch his orders to all the generals as occasion should require. He expressly prohibited Khaled and all his other officers to act offensively unless they were first attacked. Things being in this situation, the army upon a signal given put itself immediately in motion. The prophet mounted his camel with great alacrity, and was that day cloathed in red. Al Zobeir pursued the rout assigned him without opposition; nor did Saad discover the faintest traces of an enemy: Ali took possession of his post without the loss of a man; and in like manner Abu Obeidah seized on the suburbs. Khaled, however, in his march to the plain, was met by a large body of the Koreish and their confederates, whom he immediately attacked and defeated, putting 28 of them to the sword. Not content with this, he pursued them into the town, and 59 Mecca taken. massacred a great number of the inhabitants; which so terrified the rest, that some shut themselves up in their houses, while others fled different ways in order to avoid the fury of the merciless and impious tyrant, who was now become master of the city. Thus was Mecca reduced, with the loss only of two men on the side of the impostor.

Mahomet being now master of the city, made his public entry into it exactly at sun-rising. When the first tumult was over, he went in procession round the Caaba seven times, touching the corner of the black stone with the staff in his hand, as often as he passed it, with great devotion. Then he entered the Caaba; where observing several idols in the form of angels, and the statutes of Abraham and Ishmael with the arrows of divination in their hands, he caused them all to be destroyed. He also broke in pieces with his own hands a wooden pigeon, that had long been esteemed a deity by the idolatrous Koreish. Afterwards entering into the interior part of the Caaba, he repeated with a loud voice the form used at this day by the Mahometans, "Allah Akbar, God is great," &c. turning towards every part of the temple. Then he prayed between the two pillars there, with two inclinations, as well as without the Caaba; saying to those that attended him, "This is your Kebla, or the place towards which you are to turn your faces in prayer."

Having thus effectually subdued the Koreish, put an end to all commotions, and purged the Caaba of 360 idols, the prophet's next care was to ingratiate himself with the people. Sending therefore for some of the principal of them, he asked them what kind of treatment they expected from him, now he had conquered them? To this they replied, "None but what is favourable, O generous brother:" upon which he dismissed them, telling them they were from that moment a free people. After this, pretending a new revelation, he restored the keys of the Caaba to Othman Ebn Telha, who was in possession of them before; and who was now so much affected by this piece of justice, that he immediately became a proselyte. Next day the prophet declared Mecca an asylum, and publickly gave out that he would maintain to the utmost of his power the inviolable security of the place. He then was solemnly inaugurated; after which he proscribed, according to some, six men and four women, according to others, eleven men and one woman: but of these only three men and one woman were put to death; the rest being pardoned on their embracing Mahometanism, and one woman making her escape. The remainder of this year was spent in various expeditions against different tribes of the Arabs, which were in general attended with success.

Arabia. The ninth year of the Hegira, being that of Christ 631, is called by the Mahometans the year of *Embassies*; for the Arabs, who had hitherto been expecting the issue of the war between Mahomet and the Koreish, no sooner saw that which was the most considerable of the whole submit to him, than they began to come in to him in great numbers, and to send embassies to make their submissions to him, both while at Mecca and after his return to Medina, whither he had returned soon after the taking of Mecca: and this good fortune

60 Mahomet dies. continued without interruption to the year 632, when this famous impostor breathed his last, having just reduced under his subjection the whole peninsula of Arabia, and being ready to break into the neighbouring kingdoms in order to satisfy his ambition.

61 Great confusion on his death. The death of Mahomet occasioned such a consternation in Mecca, that the governor hid himself, fearing to be called to an account for his former conduct; and the inhabitants, upon the first arrival of this melancholy news, considered themselves as destitute of all manner of protection. After the first impressions of their fear, however, were over, they began to meditate a revolt; but were prevented by one Sohail Ebn Amru, a principal man of the Koreish. The tumults at Medina, however, were not so easily appeased. The news of this sad event was no sooner published there, than a number of people assembled before his door, crying out, "How can our apostle be dead? Our intercessor, our mediator, has not entirely left us! He is taken up into heaven, as was Isa (Jesus); therefore he shall not be buried." This was confirmed by Omar; who drew his sword and swore, that if any person affirmed Mahomet to be dead, he would cut off his hands and his feet. "The apostle of God (says he) is not dead: he is only gone for a season, as Moses the son of Amran was gone from the people of Israel for forty days, and then returned to them again." The populace therefore kept the body above ground, even after the belly began to swell; nor could the prophet's uncle Al Abbas, notwithstanding this, convince them to the contrary. Upon hearing of these transactions, Abu Becr immediately posted from Al Sonah, another quarter of the city, and expostulated with them in the following manner: "Do you worship Mahomet, or the god of Mahomet? If the latter, he is immortal, and liveth for ever; but if the former, you are in a manifest error, for he is certainly dead." The truth of this assertion he immediately evinced from several passages of the Koran, in so clear and conclusive a manner, that he not only satisfied Omar, but calmed the minds of all the people.

The prophet having left no directions concerning a successor, very warm disputes arose between the Mohajerin and the Ansars about the right of electing a khalif. The former insisted on having that right, because they had attended Mahomet in his flight to Medina; and the others, because they had supported him when expelled from his native city, &c. In short, the disputes became so hot, that an open rupture must have commenced, had not they been terminated by a proposal that each party should choose a khalif. This amused them a little for the present; but not proving perfectly agreeable to the Mohajerin, Abu Becr proposed two persons, Omar and Abu Obeidah, offering to swear allegiance to him on whom the suffrages of both parties should fall. But this producing no decision, Omar swore fealty to Abu Becr, and his example was followed by all the Moslems on the spot; upon which he was acknowledged both by the Mohajerin and Ansars to be the rightful successor of Mahomet. Arabia. 62 Abu Becr succeeds him.

These transactions, however, were not at all agreeable to Ali, who, as son-in-law to the prophet, had undoubtedly the best title to the succession. He expostulated with Abu Becr about the manner of his election, which had been effected without his knowledge; and received for answer, that the exigence of affairs would not admit of deliberation; and that, had not the election been so sudden, the opposite party would have wrested the power entirely out of their hands. Ali was in Fatima's apartment when Abu Becr had the good luck to be elected khalif; and, upon the arrival of the news, expressed great dissatisfaction. He found himself, however, soon obliged to change his note, when the new khalif sent Omar with orders to burn the house where he and his friends were assembled, in case he did not concur in supporting the election. But notwithstanding his forced compliance on this occasion, it is not to be doubted that he reckoned himself injured; and his pretensions were thought to be just by a great number of Moslems: which notion is entertained by a very considerable party of Mahometans even at this day; and these are called *Shiites* or *sectaries*. 63 Ali dissatisfied.

Soon after Abu Becr's accession, many of the Arabs refused to pay the tribute imposed upon them by Mahomet, and even attempted to shake off his yoke altogether. This so alarmed the khalif and his subjects at Medina, that, fearing a general revolt, they sent all not able to bear arms into the cavities of the rocks and mountains, and put themselves in as good a posture of defence as the short time would permit. In the mean time Khaled was dispatched with an army of 4500 men to reduce the rebels; and he soon coming up with them, gave them a total defeat, brought off a vast quantity of plunder, and made many of their children slaves. Nor was he content with this; for being sent by Abu Becr to Malek Ebn Noweirah, an eminent person among the Arabs, and famous for his skill in poetry as well as his horsemanship and bravery, to bring him over by fair means, he immediately ordered his head to be cut off. By this means, indeed, he extinguished all the remains of rebellion; but rendered himself exceedingly obnoxious to Abu Becr, who would have put him to death, had not Omar strongly interceded for him: for Khaled had greatly exceeded his commission, as Malek had returned to Mahometanism, and had offered to pay the money. This was not, however, the only piece of service Khaled performed at this time; he also defeated and killed Moseilama, who had set up for a prophet in the time of Mahomet, and even wanted to take the grand impostor himself into company with him. The same general likewise defeated and dispersed the troops of another prophet, called *Toleiah Ebn Khowailed*, obliging himself to remain concealed till after the death of Abu Becr. About the same time another body of rebels committed great disorders in the province of Bahrein. Against these Abu Becr dispatched Al Ola at the head of a considerable army, who soon obliged them to return to Mahometanism; having put great numbers of them to the sword, and plundered their country in a dreadful manner. 64 Rebellions extinguished by Khaled.

Abu Becr having now no enemy to contend with in 65 War with the Greeks.

Arabia.

Arabia, and being free from all apprehenſions of a competitor, reſolved next to turn his arms againſt the Greek emperor. Some ſkirmiſhes had happened, in the time of Mahomet, between the Moſlems and Greeks; in one of which Zeid, a Moſlem commander, had been killed. To revenge his death, his ſon Oſama was on the point of making an irruption into Syria at the time of Mahomet's deceaſe. This enterpriſe the khalif ordered him to go on with; and it was executed by Oſama with great ſucceſs. He entered Syria, and laid waſte the country; doing the Greeks a good deal of damage; after which he returned to Arabia without any conſiderable loſs.

66 Kingdom of Hira deſtroyed.

Soon after the khalif ſent Khaled at the head of a powerful army to invade Irak, and put an end to the kingdom of Hira. In this undertaking he was attended with his uſual ſucceſs. The king Al Mondar Al Maghrur loſt his life in defence of his dominions; and the kingdom was totally deſtroyed, after it had continued 622 years and eight months, as we have already hinted. The inhabitants became tributaries; and, according to Eutychius, the tribute collected on this occaſion amounted to 70,000 pieces of money. This, according to Al Makin, was the firſt tribute-money ever brought to Medina.

The exigence of the khalif's affairs in Syria, however, did not ſuffer Khaled long to remain in Irak. Before the departure of the army under his command, Abu Becr had come to a reſolution to invade Syria; and finding his deſign approved by the principal officers of his court, he ſent circular letters to the petty princes of Yaman, the chief men of Mecca, &c. informing them of his intention to take Syria out of the hands of the infidels; acquainting them, at the ſame time, that a war for the propagation of the true religion was an act of obedience to God. To theſe letters they paid a proper regard; and in a very ſhort time appeared at Medina at the head of their reſpective troops, and pitched their tents round the city. Here they ſtaid till the Moſlem army deſtined to act againſt the emperor was completely formed, and in a capacity to begin its march. The khalif having viewed the troops from the top of an hill, and prayed to God for ſucceſs, attended the generals a little way on foot. As the generals were on horſeback, they could not forbear expreſſing their uneaſineſs at the khalif's thus demeaning himſelf; but he told them, that it ſignified little whether they walked on foot or rode, as they had all the ſame views, viz. the ſervice of God, and the pro-

67 Abu Becr's directions to his general.

pagation of religion. At parting, he addreſſed Yezid Ebn Abu Sofian, whom he had inveſted with the ſupreme command, in the following manner; "Take care, Yezid Ebn Abu Sofian, to treat your men with tenderneſs and lenity. Conſult with your officers on all preſſing occaſions, and encourage them to face the enemy with bravery and reſolution. If you ſhall happen to be victorious, deſtroy neither old people, women, nor children. Cut down no palm-trees, nor burn any fields of corn. Spare all fruit-trees, and ſlay no cattle, but ſuch as you ſhall take for your own uſe. Adhere always inviolably to your engagements, and put none of the religious perſons you ſhall meet with in monaſteries to the ſword. Offer no violence to the places they ſerve God in. As for thoſe members of the ſynagogues of Satan *who ſhave their crowns*, cleave their ſkulls, and give them no quarter, except they embrace Iſlamiſm (Mahometaniſm), or pay tribute."

Arabia.

The Greek emperor was greatly alarmed at the approach of the Moſlem army; however, he made all neceſſary preparations for his defence, and ſent out a detachment to reconnoitre the enemy. Theſe having fallen in with the Arabs, a battle enſued, in which the Greeks were defeated with the loſs of 1200, while the Arabs loſt only 120 men. This was ſucceeded by a great many ſkirmiſhes, in which the Moſlems were generally victorious. The rich ſpoil taken on theſe occaſions was ſent as a preſent to the khalif; who having acquainted the inhabitants of Mecca with his good ſucceſs, they were thereby ſo elated, that they furniſhed him with a ſtrong reinforcement, which was immediately ordered into Syria. The Greek emperor, in the mean time, having ordered another body of his troops to advance towards the frontiers, they found an oppor-

68 The Moſlems defeated.

tunity of engaging the Moſlem army under Abu Obeidah, a perſon of great piety, but little experience in war. Him they totally defeated; and Abu Becr was ſo much provoked at his defeat, that he deprived him of the command, which was given to Khaled, who was for this purpoſe recalled from Irak. That general's firſt exploit was the reduction of Boſtra, a very rich and populous city of Syria Damaſcena; which, however, he accompliſhed by treachery rather than by force of arms. Having left a garriſon of 400 men in Boſtra, and being joined by Abu Obeidah's forces, he laid ſiege to

69 Damaſcus beſieged.

Damaſcus with an army of 45,000 men. This ſo alarmed the emperor, that he diſpatched an army of 100,000 men, commanded by one Werdan, to the relief of that city. Khaled, on hearing of the approach of this formidable army, was for marching immediately with all his forces, and giving them battle; but this was oppoſed by Abu Obeidah, as it would enable the inhabitants of Damaſcus to procure freſh ſupplies both of arms and proviſions, and conſequently render the reduction of the place more difficult. It was, therefore, at laſt agreed, that a body of troops ſhould be detached under Derar Ebn Al Wazar, an excellent officer, and an implacable enemy to the Chriſtians (as indeed were all the Moſlem generals except Abu Obeidah), to fight the enemy, whilſt the ſiege was carried on by the two generals.

70 The Greeks defeated with great ſlaughter.

Khaled, fearing leſt Derar's furious zeal and hatred to the Chriſtians ſhould prove fatal to his troops, told him before his departure, that though they were commanded to fight for the propagation of their religion, yet they were not allowed to throw away the lives of their men; and therefore ordered him to retire to the main body of the army, in caſe he found himſelf preſſed by a ſuperior force. But Derar, deaf to this ſalutary admonition, with his ſmall body of troops ruſhed upon the whole Chriſtian army; notwithſtanding the vaſt diſproportion of numbers. He charged them, however, with ſuch bravery, that he penetrated to the ſpot where the general gave his orders, killed the ſtandard-bearer, and carried off the ſtandard itſelf, in which was a croſs richly adorned with precious ſtones. Nay, he would in all probability have put Werdan's army to flight, had not the general's ſon, the commandant of Hems, arrived in the heat of the engagement with a body of 10,000 men; with which he attacked the Moſlems ſo briſkly in the rear, that he forced them to retire, and took

took Derar himſelf priſoner. This ſo diſcouraged them that they would have taken to their heels, had not Rafi Ebn Omeirah animated them with the following words. "What! do not you know, that whoever turns his back upon his enemies offends God and his prophet; and that the prophet declared the gates of paradiſe ſhould be open to none but ſuch as fought for religion? Come on! I will go before you. If your captain be dead, or taken priſoner, yet your God is alive, and ſees what you do." This exhortation had ſuch an effect upon his troops, that, returning to the charge, they maintained their ground with unparalleled bravery, till Khaled arrived with a conderable body of infantry and 1000 horſe. The arrival of this general ſoon turned the fortune of the day. A party of the imperial army went over to the Moſlems, and the reſt took to their heels. Derar alſo was retaken, and carried off in triumph. However, Werdan, having collected the ſhattered remains of his forces, and received a reinforcement from the emperor, found his army ſtill to amount to 70,000 men, with which he reſolved to make another attempt for the relief of Damaſcus. They were attended with ſtill worſe ſucceſs in this ſecond attempt than they had been before; being utterly defeated with the loſs of 50,000 men, ſo that they were no more in a condition to attempt any thing; and, in conſequence of this, the city was ſoon taken, notwithſtanding the utmoſt efforts of the beſieged.

71 The city taken.

72 Abu Becr dies, and is ſucceeded by Omar.

This diſaſtrous event happened in the year 634; and the very day that Damaſcus was taken, Abu Becr died of a conſumption in the 63d year of his age. He was ſucceeded by Omar, who was proclaimed khalif that very day; and the firſt title aſſigned him was, *The khalif of the khalif of the apoſtle of God.* But the Arabs conſidering, that by the additions to be continually made at the acceſſion of every new khalif, the title would become too long, they with one voice ſaluted him, *Emperor of the believers;* which illuſtrious title deſcended afterwards to his ſucceſſors by a kind of inconteſtable right.

The new khalif was no ſooner ſettled than he replaced Abu Obeidah in the command of the army in Syria, being greatly diſpleaſed with the cruel and bloodthirſty diſpoſition of Khaled. He alſo commanded Abu Obeidah to have an eye upon Paleſtine, and to invade it as ſoon as an opportunity offered. Khaled bore his diſgrace with great magnanimity; and ſwore, that though he had always had the greateſt regard for Abu Becr, and the utmoſt averſion to Omar, he would ſubmit to God's will, and obey the new khalif as the lawful ſucceſſor of Mahomet. The Moſlem forces in the mean time having made all proper diſpoſitions for improving the advantages they had gained, Abu Obeidah ſent a detachment of 500 horſe to a place called *Dair Abil Kodos*, about 30 miles from Damaſcus, to plunder the Chriſtians there. In this place their lived a prieſt ſo eminent for his ſanctity, that the neighbouring people of all ranks reſorted to him for his bleſſing and inſtruction. When any perſon of diſtinction married, he took with him his new ſpouſe, in order to receive this holy man's benediction. The fame of this prieſt's ſanctity drew ſuch numbers of people to that place every Eaſter, that a great fair was kept annually at his houſe, to which were brought vaſt quantities of the richeſt ſilks, plate, jewels, &c. When the Arabs drew near to this place, to which they were conducted by a Chriſtian, they were informed that the governor of Tripoli had married his daughter to a perſon of diſtinction, who had carried his lady to the above-mentioned prieſt. She was attended by a guard of 5000 men; beſides which, the Jews, Greeks, Copts, and Armenians, at that time aſſembled about the monaſtery, amounted to 10,000. Notwithſtanding this the Moſlem commander determined to cary off the lady; and having told his men, that they ſhould either enjoy the riches of the Chriſtians, or the pleaſures of paradiſe, he commanded them to fall on the enemy. The impetuoſity of theſe enthuſiaſts at firſt bore all down before them; but the Chriſtians perceiving they were but an handful of men, ſurrounded them on all ſides, and reſolved to make them pay dear for their temerity. But Abu Obeidah, being informed of their dangerous ſituation, immediately diſpatched Khaled with a ſtrong detachment to the relief of his diſtreſſed countrymen. The conſequence of this was, that the Chriſtians were entirely defeated, and the unhappy lady carried off, with 40 maids that waited upon her, as well as all the wealth brought to the above-mentioned fair; among which were many rich garments curiouſly wrought, and in particular one adorned with the effigies of our Saviour. All theſe were ſold for ten times their weight of gold to ſome of the opulent Arabs of Yaman. The young lady was given to Abdallah, who kept her to the reign of Yezid. Of this advantage Abu Obeidah ſent notice to the khalif by a letter, in which he alſo acquainted him that ſome of his men had drunk wine. Theſe delinquents, by the advice of Ali, had each of them 80 ſtripes beſtowed upon the ſoles of their feet; after which many others, who had never been ſuſpected of drinking this prohibited liquor, made a voluntary confeſſion, and received the ſame chaſtiſement.

73 Governor of Tripoli's daughter carried off.

74 Puniſhment of ſome ſoldiers who had drunk wine.

The Moſlem general next ſet about reducing the principal fortreſſes in Syria, and ſoon became maſter of Kinniſrin, Baalbec, Adeſtan, Shaizar, and Hems; on the news of which, the Greek emperor Heraclius, reſolving if poſſible to put a ſtop to the cruel and unprovoked ravages of theſe barbarians, ſent againſt them an army of 240,000 men, commanded by one Manuel, whom the Arabs call *Mahan*. But this vaſt multitude was utterly defeated by Khaled; upon whom Abu Obeidah conferred the ſupreme command, on account of his ſuperior ſkill in military affairs. This battle was fought near a village called *Yermouk*; and according to the Arabian hiſtorians, the Chriſtians had 150,000 men killed, and 40,000 taken priſoners, while the Moſlems loſt no more than 4030 men.

75 The Greeks utterly defeated at Yermouk.

76 Omar viſits Jeruſalem.

The defeat of Yermouk was immediately followed by the loſs of the whole province of Paleſtine. The reduction of Jeruſalem was one of its firſt conſequences; and Omar being appriſed of the ſucceſs of his arms, immediately ſet out to viſit that holy place, at the requeſt, it is ſaid, of the inhabitants. The khalif was attended in his journey by a numerous retinue, moſt of whom afterwards returned home. He rode upon a red camel, and carried with him two ſacks, one of which contained a ſort of proviſion conſiſting of barley, rice, or wheat, ſodden and unhuſked, and the other fruits. Before him he had a leather bottle, very neceſſary in theſe deſart countries to put water in; and behind him

a wooden platter. Before he left the place where he had rested the preceding night, he constantly said the morning prayer; after which he addressed himself to his attendants in a devout strain, always uttering before them some pious ejaculations. Then he communicated his provision to them; every one of his fellow-travellers eating with him out of the same platter, without the least distinction. His clothes were made of camels hair, and were in a very tattered condition; nor could any thing be more mean or sordid than the figure he made. On the road he distributed justice among his subjects: concerning which we have several
77 Anecdote of him. anecdotes; but that most to his honour is the following. Having observed some poor tributaries exposed to the heat of the sun, a very cruel punishment in those hot countries, for not being able to pay the sum demanded of them, he ordered them to be released; telling his attendants, that he once heard the apostle of God say, "Do not afflict men in this world; for those who do so, God shall punish in hell-fire at the day of judgement." His orders were immediately executed, to the great grief of the oppressors; and the khalif continued his route. On the confines of Syria he was met by Abu Obeidah attended by an escorte, who conducted him to the Moslem camp, where he was received with the utmost demonstrations of joy; and from thence to Jerusalem. The morning after his arrival, he said prayers and preached to the troops. In his sermon he repeated the following passage out of the koran, "Whomsoever God shall direct, he shall be rightly directed; and whomsoever he shall cause to err, thou shalt not find any to defend or to direct." Upon this a Christian rose up, and said aloud twice, "God causes no one to err." Omar made no answer to him, but commanded the Moslems near him to strike off the infidel's head if he repeated those words again; but the priest took care to give him no further interruption. After the conclusion of his sermon, he pitched his tent, made of hair, within sight of the city: then he signed the articles of capitulation; by which the inhabitants were intitled to the free exercise of their religion, the possession of their properties, and his protection.

The articles of capitulation being signed, Omar, in pursuance of his engagements, gave the inhabitants a schedule, by which they were secured in the full possession of all that had been agreed upon; after which the gates were opened to him, and he entered the town. He was waited upon by the patriarch Sophronius, with whom he conversed familiarly, and asked him many questions concerning the antiquities of the city. One of the first places they visited was the temple of the resurrection, in the midst of which Omar sat down; and when the hour of prayer was come, told the patriarch he had a mind to pray, and desired him to show him a place for that purpose. Sophronius told him he might do so where he was; but this he absolutely refused. Then the patriarch led him to St Constantine's church; but he likewise declined praying there. At last he said his prayers upon one of the steps of the east gate of the church; telling the patriarch afterwards, that had he prayed in any of the churches, the Moslems would infallibly have taken it from them, which he said they might attempt as it was, and therefore gave him a paper, wherein the Moslems were commanded not to pray on the steps of St Constantine's church in any numbers, but only one by one. After this he desired the patriarch to show him a place where he might erect a mosque; and was conducted to the place where Jacob's stone lay, on which he slept when he saw the vision of the ladder. This stone had been hitherto slighted, and no building suffered to be erected upon it, in order to fulfil our Saviour's prophecy, that the habitation of the Jews should be left unto them desolate, and that not one stone should be left upon another. In consequence of this neglect it was entirely covered with dirt, which the khalif immediately began to carry away in his vest; and the Moslems soon hastening to assist him, the stone was cleared in a very short time. We are told by Theophanes, that when Omar entered the temple of the resurrection, he was clad in such mean and dirty apparel, that the patriarch took great offence at his appearance, and with much difficulty at last prevailed upon him to put on some clean linen and clothes till his own could be washed. The same author relates, that when the patriarch first saw Omar in that place, he could not forbear crying out, "This is of a truth the abomination of desolation, spoken of by Daniel the prophet, standing in the holy place!" These words, as Mr Ockley imagines, being overheard by the Moslems, they trumped up a story of the patriarch's having owned that the conquest of Jerusalem by Omar was foretold by the prophet Daniel; and that an ancient prophecy was kept in Jerusalem concerning Omar, wherein his person was described, his name and religion specified, and he declared to be the only man that could reduce that city.

Before the khalif left Syria, he divided that country into two parts; one of which, that lay between Haûran or Aûran and Aleppo, which was not perfectly conquered, he committed to the care of Abu Obeidah, giving him the strictest orders to reduce it as soon as possible. Yezid Ebn Abu Sofian was commanded to take upon him the care of the other, which comprehended Palestine, and the sea-coast, and to make himself absolute master of it, having a body of troops assigned him for that purpose. He also directed Amru Ebn Al As to invade Egypt, then in a very languishing condition, with a body of Moslem forces. After having made these dispositions for extending his conquests, Omar set out for Medina, where he arrived in perfect health, to the great joy of the inhabitants, who apprehended, from his long stay at Jerusalem, that he had intended to fix his residence there. 78 He returns to Medina.

Soon after Omar's departure, Yezid advanced to Cæsarea; but found the place so strong, that he was obliged to continue some time in a state of inaction. Abu Obeidah, in the mean time, advanced towards Aleppo, the citadel of which was at that time the strongest in Syria. The citizens were struck with the utmost consternation at his approach. They had at that time two governors, who were brothers, and resided in the castle, which was situated at a little distance from the city. The names of these two governors, who were of very different dispositions, were Youkinna and John. Their father, by the emperor Heraclius's appointment, presided over all that tract which lay betwixt Aleppo and the Euphrates; and, after his death, the chief management of affairs devolved upon Youkinna, his brother John spending his time mostly in devotion and acts of charity.

charity. He would therefore gladly have prevailed on Youkinna to purchase a peace from the Arabs with money, rather than make his country a scene of blood and ravages; but this not suiting the martial genius of Youkinna, he armed a considerable number of the citizens, among whom were several Christian Arabs, and distributed money among them. He then told his men that he intended to act offensively against the Arabs, and even to engage them if possible before they drew too near. To inspire them with the greater resolution, he observed, that the Moslem army was divided into several bodies; one of which had orders to besiege Cæsarea, another to march to Damascus, and the third to invade Egypt. Having thus animated his troops, he put himself at the head of 12,000 of them, and march-
79 ed forwards to get intelligence of the enemy's motions. Abu Obeidah, in the mean time, had sent before him Caab Ebn Damarah, with 1000 men; giving him express orders not to fight till he had received information of the enemy. Youkinna's spies discovered Caab and his men resting themselves and watering their horses without the least apprehension of danger; of which the general being apprised, he posted one part of his troops in ambuscade, and with the other attacked the Moslems. The Arabs behaved with their usual valour; and at first repulsed the Christians, notwithstanding their superiority in numbers: but being attacked by the troops that lay in ambush, they were at last forced to retire; having 170 killed, and almost all the rest
80 wounded.

A Moslem detachment defeated by Youkinna.

Aleppo submits to Abu Obeidah.

After Youkinna's departure, the inhabitants of Aleppo, considering the calamities that awaited them if their city should be taken by storm, submitted without delay to Abu Obeidah, and were taken under the protection of the khalif. This disagreeable news being communicated to Youkinna, he posted home with all possible expedition, lest an attempt should be made on the castle in his absence. On his arrival at Aleppo, he was so highly incensed against the inhabitants, that he threatened them with death if they did not disannul
81 the treaty with the Arabs, and deliver up the authors of it into his hands. This demand not being immediately complied with, he fell upon the citizens with great fury, and killed 300 of them; among whom was his brother John, whose head he caused to be struck off, charging him with being the author and abettor of the late pernicious scheme. He would have made a much greater slaughter, had not the Moslem army at that instant arrived before the town; upon which Youkinna retired into the castle with a considerable body of troops: but before this could be effected, he was obliged to sustain an attack from the Arabs, in which he lost 3000 men. The action was no sooner ended than the inhabitants of Aleppo brought out forty of Youkinna's men, and as a proof of their fidelity delivered them into Abu Obeidah's hands. Of these, seven embraced Mahometanism, and the rest were beheaded.

Cruelty of Youkinna.

82 Immediately after Youkinna had shut himself up in the castle, a council of war was held in the Moslem camp, wherein it was deliberated what measures were to be pursued on the present occasion. Khaled gave it as his opinion, that the castle ought immediately to be attacked with all the Arab forces, before the emperor had time to send them any assistance. This advice was followed by Abu Obeidah, who caused the citadel to be immediately invested; and soon after he had surrounded it with all his forces, made a most vigorous assault. The besieged defended themselves with great bravery, and after a very warm dispute drove the enemy into their camp; and as they threw a great many stones out of their military engines, many of the Moslems were killed, and a much greater number wounded. This encouraged Youkinna to make a sally with a strong party of the garrison the following night. The fires being then out in the Moslem camp, and the besiegers not expecting such an unseasonable visit, 60 of them were killed on the spot, and 50 taken prisoners. Youkinna, however, being briskly attacked by Khaled, who soon drew together a body of troops to oppose him, lost about 100 men in his retreat. The next day, he caused the prisoners to be beheaded in the sight of the Moslem camp; and receiving advice that a strong party of Arabian cavalry was sent out to forage, he ordered a body of his horse to drive them to their camp; which they accordingly did, killed 130 of them, seized all their camels, horses, &c. and then retired to the mountains. Here they proposed to remain concealed till the following night, and then return to the castle; but Abu Obeidah, being informed of what had happened, detached Khaled and Derar with a body of troops to pursue the Greeks, and revenge the late affront. Khaled, being informed of the route the Christians had taken, possessed himself of the only pass by which they could return to the castle; and having posted there a body of his men whose courage he could depend upon, took 300 of the Greeks prisoners as they attempted to return, and put all the rest to the sword. The next morning, to retaliate Youkinna's cruelty, the prisoners were all brought out and beheaded in the sight of the garrison. 83

He is besieged in the citadel.

Notwithstanding this disaster, Youkinna made several sallies with good success, wherein he killed a great number of the enemy, and harrassed them to such a degree, that Abu Obeidah found himself obliged, for his greater security, to remove his camp to about a mile's distance from the castle; by which manœuvre he likewise hoped that Youkinna would be less upon his guard. Herein, however, he found himself mistaken: for the Greek commander, by the prudent measures he took, eluded all surprise; and tho' Abu Obeidah continued the siege for four months after the last-mentioned blow given to the garrison by Khaled, yet he had scarce any hopes of making himself master of it at last. Having nothing material to write to the khalif, he remained a long time silent; at which Omar being very much concerned, wrote to him, desiring an account of the affairs in Syria. Abu Obeidah acquainted him that the city of Aleppo had submitted to him; and that the citadel was the only place which held out in all that country, before which he had lost a great number of men, which he said, had induced him to think of raising the siege, and moving with his army in that track which lay between Antioch and Aleppo. This news was by no means agreeable to the khalif, who commanded his general to continue the siege at all events, and sent him a reinforcement of Arab troops, together with 70 camels, to assist the infantry in their march. 84

His vigorous defence.

Among the troops sent by Omar on this occasion, there was an Arab of a gigantic size, called *Dames*,

The citadel taken by stratagem.

Arabia.

who was a man of great courage and resolution. He observing the little progress made by the Moslems, bethought himself of a stratagem by which that fortress might be reduced, which seemed so difficult to be accomplished by force. He therefore desired that Abu Obeidah would assign him the command of a party consisting only of thirty men; which at Khaled's request was readily granted. Then he begged the general to raise the siege, and retire to about three miles distance from the castle, which was likewise immediately complied with. The following night Dames, who had posted himself with his party very near the citadel, found means to seize a Greek, from whom he learned that Youkinna, after the siege was raised, had exacted large sums of money from the citizens, on account of the treaty they had concluded with the Arabs; and that he was one of those who had endeavoured to make their escape from the oppression of such a tyrant, by leaping down from the wall. This man Dames took under his protection; but beheaded five or six others who fell into his hands, and could give no good account of themselves. He then covered his head and shoulders with a goat's skin, and took a dry crust in his hand, creeping on the ground till he got close to the foot of the wall. If he heard any noise or suspected any person to be near, he made such a noise with his crust as a dog does when he is gnawing a bone, his companions sometimes walking, and sometimes creeping after him in the same manner. He had before dispatched two of his men to Abu Obeidah, to desire that a detachment of horse might be sent him by break of day to support his small party, and facilitate the execution of the plan he had formed. At last Dames found an opportunity of raising seven men upon his shoulders, who stood one upon another's shoulders in such a manner that the highest reached the top of the wall. Here he soon placed himself, seized a watchman whom he found asleep, and threw him over the wall. Two others, whom he found in the same condition, he stabbed with his dagger, and threw them over likewise. Then he laid down his turban, and drew up the second of his brethren, as they two did the third, and by their help Dames himself and all the rest were enabled to mount the wall. He then privately stabbed the centry at each of the gates, and put his men in possession of every one of them. The soldiers of the garrison, however, were at last alarmed, and surrounded the Arabs, who were on the point of perishing, when Khaled appeared at the head of a detachment of cavalry. On sight of that general, who was now grown terrible to the Christians, the besieged

85 Youkinna's apostacy.

threw down their arms and surrendered at discretion. Youkinna and some of the principal officers turned Mahometans, in order to save their possessions; and the castle, being taken by storm, was pillaged by the Moslems. Dames acquired great glory by this exploit; and, out of complaisance to him, the army did not decamp from Aleppo till he and his men were perfectly cured of their wounds.

After the reduction of the citadel of Aleppo, Abu Obeidah intended to march to Antioch; but was diverted by Youkinna, who was now become a violent enemy to the Christians. He told the Moslem general, that his conquest of that part of the country would not be complete without the reduction of Azaz, a place of great importance, where Theodorus, Youkinna's cousin-german, was commandant. This fortress he proposed to become master of, by putting himself at the head of 100 Arab horse dressed in the Greek habit, who were to attend him to Azaz. Upon his arrival there, he was to assure Theodorus that he was still in reality a Christian, and had taken that opportunity to escape from the Moslem camp. But, to make his story more probable, Abu Obeidah was to send after him a detachment of 1000 horse, who were to pursue him as far Morah, a village in the neighbourhood of Azaz, with orders to post themselves there; from whence, if such a measure should be found necessary, they might easily advance to Azaz, to facilitate the conquest of that place. To this scheme Abu Obeidah agreed; but Youkinna with all his men were immediately taken prisoners by Theodorus, who had been informed of the whole affair by a spy in the Moslem camp, who had sent him a letter by a pigeon. The fortress, however, was soon reduced, and Youkinna re- 86

He is taken prisoner & brought before Heraclius.

gained his liberty; but was soon after taken prisoner a second time, and brought before his old master Heraclius, who then resided at Antioch. He told the emperor, that he had only pretended to embrace Mahometanism, in order to be able to do his Imperial Majesty the more essential service; and so far gained upon him, that he was soon after appointed governor of that city; the consequence of which was, that the Arabs were put in possession of it by his treachery. 87

Attempt to assassinate Omar miscarries.

The emperor being quite disheartened at his continual bad success, it was suggested to him by the king of Ghassan, who had fled to him for refuge, as we have already observed, that, however desperate his affairs might be, they would be perfectly restored by the assassination of the khalif. This piece of service he undertook to perform for the emperor; and dispatched one Wathek Ebn Mosafer, an Arab of his tribe, and a resolute young man, to Medina for that purpose. Wathek, some time after his arrival there, having observed the khalif to fall asleep under a tree, on which he had placed himself so as not to be observed by any one, drew his dagger, and was upon the point of stabbing him; but, as the Arab writers tell us, he was deterred by a lion, who walked round the khalif, and licked his feet till he awoke, after which he instantly went away. This struck Wathek with a profound reverence for Omar; he came down from his tree where he had been confined by the lion, confessed his design, and embraced the Mahometan religion. 88

The Greeks defeated.

Soon after the reduction of Antioch, Abu Obeidah sent an account of his success to Omar; and receiving an order to invade the mountainous parts of Syria, he asked his general officers which of them would command the body of troops destined for that purpose. One Meisarah Ebn Mesrouk having offered his service, the general gave him a black standard, with the following inscription upon it in white letters: "There is but one God; Mahomet is the Apostle of God." The body assigned him for this purpose consisted of 300 Arabs, and 1000 black slaves commanded by Dames. Meisarah, at the head of his troops, with some difficulty ascended the mountains, and, with much more, advanced to that part where the emperor's forces were posted. The cold was so intense on the summits of those mountains, that the Arabs, who had been

been accustomed to a warm climate, could hardly bear it. For some time they could not meet with a single person to give them intelligence of the enemy's motions; but at last they took a Greek prisoner, who informed them, that the imperial army, which consisted of 30,000 men, lay encamped on a spot not three leagues distant. The prisoner refusing to profess Mahometanism, they cut off his head, and then marched towards the imperial camp. The Greeks, hearing of their approach, advanced to meet them; and the Moslems being surrounded on all sides, were on the point of being all cut off, when Khaled appeared at the head of 3000 horse, and after him Ayab Ebn Ganem with 2000 more. At the approach of the horse under the command of the terrible Khaled, the Greeks retired, leaving all their tents, together with their rich furniture and effects, to the Arabs. In this engagement, one of Omar's chief favourites, named *Abdallah Ebn Hodasa*, was taken prisoner, and sent directly to Constantinople. The khalif was so much concerned at this, that he sent a letter to Heraclius, desiring his release; which the emperor not only complied with, but made him many valuable presents, sending at the same time a jewel of immense value as a present to the kha-

89 Omar's disinterestedness.

lif. This Omar offered to the jewellers of Medina, but they were ignorant of its value: the Moslems therefore begged him to keep it for his own use; but this he said he could not be answerable for to the public. It was therefore sold, and the money deposited in the public treasury.

About this time also, Khaled advanced with a body of troops as far as the Euphrates, and took Manbij, Beraa, Bales or Balis, exacting of the inhabitants 100,000 dinars for their present security, and imposing on them an annual tribute for the future. He also made himself master of Raaban, Dulouc, Korus, the Cyrus or Cyrrhus of the ancients, and several other fortified towns, nothing being now able to stand before him. Amru Ebn Al As now likewise prepared for the reducing some places in Palestine that still held out. While he remained in this province, he had a conference with Constantine the emperor's son, who endeavoured to persuade him to make peace with the Christians; but this he not agreeing to, unless they would consent to pay tribute, all hopes of an accommodation vanished and the generals on both sides prepared to enter upon action. In the mean time an officer came from the Christian camp, dressed in very rich apparel, who challenged the stoutest man among the Moslems to fight him in single combat. The challenge was accepted by a young Arab officer of Yaman; who being animoted by a notion, derived from the prophet himself, that "the spirits of the martyrs rest in the crops of green birds, that eat of the fruits and drink of the rivers of paradise," discovered an uncommon eagerness to encounter his enemy. But the Christian officer not only killed this youth, but two or three more of the Moslems who came to his assistance. He was then attacked by Serjabil Ebn Hosanah, one of the generals, but a man so weakened by fasting, that he could scarce

90 Account of Toleiha the false prophet.

stand before him, and would therefore have been undoubtedly killed, had not a Greek horseman very opportunely interposed, and with one blow of his scymitar cut off the Christian's head. Serjabil, greatly surprised at this deliverance, asked the horseman who he was, and from whence he came; to which he replied in the following terms: "I am the unfortunate Toleiha Ebn Khowaid, who set up for a prophet, and, lying against God, pretended to inspiration." In consequence of having saved his life, Serjabil introduced him to Amru; and writing a letter to Omar, wherein he acquainted him with the signal proof Toleiha had given of his repentance, he obtained his pardon from the khalif.

Though the two armies did not come to a general engagement, yet they had frequent skirmishes, in which the Arabs always got the better, and in some the Greeks suffered very considerably. This, together with the severity of the season, which was then uncommonly cold, so dejected the soldiery, that they began to desert in great numbers. Constantine therefore, finding his troops to diminish daily, and the Arabs to grow stronger and stronger, took the advantage of a tempestuous night to escape to Cæsarea, which Yazid had not been able to take, leaving his camp to be plundered by the enemy.

91 Youkinna takes Tripoli.

This city was soon after invested by Amru; and at the same time Youkinna, having made himself master of Tripoli by treachery, seized 50 ships from Cyprus and Crete, which carried a supply of arms and provisions for the emperor's troops, and had entered the port without knowing that the Arabs were masters of the town. With these ships he undertook an expedition against Tyre; and telling the inhabitants that he brought a supply of arms and provisions for Constantine's army, he was admitted into the town, and received with great kindness. Here, however, he had not been long before he was discovered by one of his own soldiers, and put under arrest, with 900 of his men. He was however set at liberty by those to whose care he was committed;

92 Tyre and Cæsarea reduced.

and then opened the gates of the town to Yezid, by whom it had been invested. Constantine having got intelligence at Cæsarea of the loss of Tripoli and Tyre, was so disheartened, that he set sail from that city with all his family and the greatest part of his wealth; and the citizens then thought proper to make the best terms they could with Amru. The surrender of this city was followed by that of all the other cities and fortresses in the province; and thus the Arabs drove the Greeks out of the whole country of Syria extending from the Mediterranean to the Euphrates. This conquest was completed in the 18th year of the Hegira, six years after it had been undertaken.

93 Violent storms, plague, &c.

This year there happened such violent storms of hail in the peninsula of the Arabs, that a considerable extent of territory was laid waste by them, and a great number of animals of various kinds destroyed. An epidemical distemper likewise raged at Medina, which spread itself all over the neighbouring territory, and swept away great numbers of people. Syria also was visited by a dreadful plague; so that the Moslems lost there 25,000 men, among whom were Abu Obeidah himself, Yezid Ebn Abu Sofian, Serjabil, and many other persons of distinction. In short, so great was the mortality, occasioned by the plague, both in Arabia and Syria, that the Arabs style the 18th year of the Hegira the *year of destruction*.

94 Egypt reduced.

Amru Ebn Al As having now executed the khalif's orders in Syria, set out on his expedition against Egypt. His first attempt was on Tarma, a town situated on the isthmus of Suez. This he reduced after a month's siege;

 fiege; and having narrowly viewed its fituation, he formed a defign of cutting through the ifthmus, and thus joining the Mediterranean and the Red fea: but this project was not well relifhed by the khalif, who apprehended that it would facilitate the entrance of the Chriftians into the peninfula of Arabia. From Tarma he marched to Mefr, the Memphis of the ancient geograpers; which, after a fiege of feven months, was delivered up to him by the treachery of Al Mokawkas the Governor. From Mefr, he continued his march towards Alexandria, and, having defeated the emperor's army, clofely invefted that city. While his army lay before this capital, Amru himfelf had the misfortune to be taken prifoner and carried into the town. Being brought before the governor, he afked him why he committed fuch ravages and depredations in the Chriftian territories? To this Amru refolutely anfwered, "We have come hither to oblige you either to profefs Mahometanifm, or pay an annual tribute to the khalif; to one of which conditions you muft fubmit, or be all of you put to the fword." A Greek who ftood by, hearing this, told the governor that Amru was certainly the Moflem general, and therefore defired him to cut off his head. Upon this Werdan, one of Amru's flaves, perceiving the extreme danger his mafter was in, gave him a box on the ear, exclaiming againft his impudence for talking in fuch a manner. The governor being impofed upon by this fhallow artifice, not only faved his life, but, to fhow his generofity, difmiffed him without ranfom. This was foon followed by the lofs of Alexandria, and that by the conqueft of the whole kingdom: after which, Amru difpatched Okba Ebn Nafe with a body of troops to penetrate farther into Africa; and that general made himfelf mafter of all the country lying between Barka and Zoweilah, reducing under his dominion alfo that part of the continent which now forms the piratical kingdom of Tripoli in Barbary.

95 Together with Barca and Tripoli.

Soon after the Moflems had made themfelves mafters of Alexandria, a grievous famine raged in Arabia, particularly at Medina, then the refidence of the khalif. This obliged Omar to write to Amru to fend him a fupply of corn, with which Egypt at that time abounded. In compliance with this order, Amru fent a train of camels laden with corn, in a continued line from Egypt to Medina; the firft of which were entering Medina when the laft were leaving Alexandria. But this method of conveying corn proving too tedious and expenfive, he ordered him to clear the Amnis Trajanus of Ptolemy, now the Khalis, which runs from one end of Cairo to the other, of the fand and gravel with which it was choaked. This he accordingly did, and by that means rendered the communication between Egypt and Arabia much more eafy than it had formerly been.

96 The Perfians defeated.

While the Arabs thus extended their conquefts in the weft, they were no lefs fuccefsful in the eaft. We have already taken notice of Khaled's having been fent into Irak to reduce the kingdom of Hira, and of his being recalled to affift in the conqueft of Syria. As the kings of Hira were under the protection of the Perfian monarchs, the deftruction of that kingdom neceffarily brought on a war with the Perfians. After the departure of Khaled, the command of the forces was left with Ebn Obeid Ebn Mafud, together with Al Mothanna Ebn Haretha, Amru Ebn Hafem, and Salit Ebn Kis. Abu Obeid having paffed a river contrary to the advice of the other generals, was killed, and his troops in great danger; however, Al Mothanna made an excellent retreat, and repaffed the river without any confiderable lofs. After this he fortified himfelf in his camp till he received a confiderable reinforcement from the khalif; when the Moflem army marched to Dir Hind, and thence continued to make frequent excurfions, ravaging that part of Irak that lay next to the Euphrates, a body of 12,000 chofen horfe was now difpatched againft thofe invaders, under the command of one Mahran. At firft the Perfians had the advantage, and obliged the Arabs to retire; but they were foon brought back by Al Mothanna, and the battle lafted from noon till fun-fet. At laft Al Mothanna, engaging Mahran in fingle combat, laid him dead at his feet; upon which the Perfians fled to Al Madayen, a town fituated on the Tigris, about a day's journey from Bagdad. After this a powerful army was difpatched by the Perfians under the command of one Ruftam; but he alfo was killed, and his troops were entirely difperfed. At the fame time Abu Mufa, another Moflem general, defeated a formidable body of troops under the command of Al Harzaman, a noble Perfian, at Ahwaz.

Not content with thofe victories, foon after the reduction of Damafcus, the khalif difpatched Saad Ebn Abu Wakkas, to diflodge the Perfians from fome diftricts they poffeffed in the neighbourhood of the Euphrates. Saad having drawn together a body of 12,000 men, advanced to Kadefia, a city bordering upon the defarts of Irak; where having utterly defeated an army of 120,000 Perfians, he made himfelf mafter of the opulent city of Al Madayen, and poffeffed himfelf of Yezdejerd's treafure; which was fo rich, if we may believe the Arabian writers, that Saad took out of it three thoufand millions of dinars, amounting to two thoufand and twenty-five millions of pounds fterling; an enormous and almoft incredible fum. From thence Saad went to that part of the palace where the king's plate was depofited, which he carried off, as well as an immenfe quantity of camphire with which another part of the palace was entirely filled. This laft the Arabs feem to have carried off merely for the fake of plundering, as they were fo much unacquainted with the nature of it, that they mixed it with their bread, which gave it a bitter and difagreeable tafte. Afterwards the Arab general carried off the crown and royal garments, adorned with gold and jewels of ineftimable value. He alfo plundered his armoury, which was well ftored with all forts of weapons; after which he caufed the roof of his porch to be opened, where he found another treafure equal in value to ten millions of crowns. He alfo found among the furniture of the palace a piece of filk tapeftry, 60 cubits fquare, which was adorned with a great variety of beautiful flowers, herbs, and plants, formed of gold, filver, and jewels, the moft valuable that could be procured. This being brought to Omar, he cut in pieces, and diftributed it among the Moflems; and that part of it which fell to Ali's fhare, and which was yet none of the beft, he fold for 20,000 crowns.

97 Incredible treafure taken from them.

In the twentieth or twenty-firft year of the Hegira, the Arabs, ftill unfated with conqueft, invaded Mefopotamia under Aiyad Ebn Ganem, where the city of Edeffa fubmitted on the firft fummons. From Edeffa

98 Mefopotamia reduced.

Arabia.

deſſa he marched to Conſtantia, or Conſtantina, ſuppoſed to be the Nicephorium of the ancients. This he took by ſtorm, as likewiſe Daras, where he maſſacred all the people he found in the place; and theſe repeated ſucceſſes ſo terrified the reſt of the fortified towns, that they all ſubmitted without reſiſtance. At the ſame time Al Mogheirah Ebn Shaabah, one of the khalif's commanders, made himſelf maſter of Shiz, a place famous for the birth of Zerduſht the Perſian philoſopher, and over-ran the whole province of Aderbijan. He alſo poſſeſſed himſelf of all the country of Armenia bordering on mount Taurus; nay, he in a manner obliged the whole region to own the authority of the khalif, and penetrated into Cappadocia. The ſame year alſo Saad made himſelf maſter of Ahwas, the capital of Khuzeſtan (the ancient Suſiana); in conſequence of which he became maſter of the greateſt part, if not of the whole, of that province; at the ſame time

99 that Al Nooman conquered the greateſt part of Khoraſan.

Omar murdered.

But while Omar's troops were thus irreſiſtibly over-running the fineſt conntries in the known world, a period was put to his conqueſts and his life, by a Perſian named *Abu Lulua*, who ſtabbed him thrice in the belly while he was performing his devotions at Medina. The reaſon of this was becauſe the khalif refuſed to remit him ſome part of the tribute, which according to the Mahometan cuſtom he was obliged to pay for the free exerciſe of his religion. The Arabs, perceiving that he had killed their ſovereign, immediately ruſhed upon him; but the aſſaſſin defended himſelf ſo deſperately, that he killed ſeven of them and wounded 13: but at laſt one the khalif's attendants threw his veſt over him, and ſeized him; upon which he ſtabbed himſelf, and ſoon after expired.

Omar having languiſhed three days after the wounds

100 given him by the Perſian, expired in the 10th, 11th, or 12th year of his reign, and after his death Othman Ebn Affan was choſen; though Ali had a better title, and ſeems indiſputably to have been the moſt virtuous, if not the only virtuous perſon, as well as the braveſt warrior among them. He was inaugurated in the 24th year of the Hegira, nearly coincident with the year of our Lord 645.

Succeeded by Othman.

Othman was no ſooner ſettled on the throne, than he commanded Al Mogheirah to complete the conqueſt of the territory of Hamadan; which he eaſily accompliſhed, and at the ſame time reduced Bira, a ſtrong caſtle in Meſopotamia, which either had never ſubmitted, or had revolted on the departure of the Moſlem troops out of that province. Another army, under Abdallah Ebn Amar, was alſo diſpatched into Perſia, to deprive Yezdejerd of the poor remains of his dominions; and this was done ſo effectually, that the unhappy monarch was obliged to fly to Sijeſtan and abandon Perſia altogether.

In the 27th year of the Hegira, the iſland of Cyprus was reduced by Moawiyah; who ſoon after conquered the iſland of Aradus, and took Ancyra; after

101 which he reduced the iſland of Rhodes, broke in pieces the famous Coloſſus, and ſold the metal of it to a Jew of Edeſſa.

Coloſſus of Rhodes deſtroyed.

In the mean time another of the Arab commanders entered Iſauria, where he committed dreadful depredations, plundering many towns and villages, putting a great number of people to the ſword, and carrying off 5000 priſoners. In the 31ſt year of the Hegira, one Habib having made an irruption into that part of Armenia which was ſtill unconquered, defeated a body of the Emperor's troops, purſuing them as far as mount Caucaſus, and laying waſte all the neighbouring territory. About the ſame time alſo, Abul Abar, who had been conſtituted admiral by Moawiyah, gave the emperor Conſtance a ſignal defeat by ſea, on the coaſt of Lycia, in which ſuch a number of Chriſtians were killed, that the neighbouring ſea was dyed with their blood.

Arabia.

But while Othman was thus carrying every thing irreſiſtibly before him abroad, he neglected to ſecure the affections of his ſubjects at home, which ſoon proved his ruin. 102

Inſurrections againſt the khalif.

Sedition was induſtriouſly propagated through all the provinces of the empire, and articles of accuſation brought againſt the khalif. The chief of theſe were, That he had recalled one who had been baniſhed by the prophet: that he had removed Saad, an officer of diſtinguiſhed bravery, and ſupplied his place by one who drank wine, and was otherwiſe of a ſcandalous life; that he had ſquandered away vaſt ſums among his favourites; that he had removed Amru from the government of Egypt, to which he had preferred his own foſter-brother; and, laſtly, that he had preſumed to ſit on the top of Mahomet's pulpit, whereas Abu Becr had always ſat on the higheſt ſtep and Omar on the loweſt. To this formidable accuſation the poor khalif pleaded guilty, and promiſed to make all the reparation in his power; but his condeſcenſion only ſerved to increaſe the inſolence of the rebels. They were however appeaſed by Ali; and public tranquillity had undoubtedly been reſtored, had it not been for Ayeſha, one of Mahomet's widows, who procured the deſtruction of the khalif by a ſcheme truly worthy of the wife of ſuch an huſband. That traitreſs, being deſirous of raiſing one of her favourites named Telha to the dignity of khalif, prevailed on Merwan the ſecretary of ſtate to write a letter to the prefect of Egypt, enjoining him to put to death Mahomet Ebn Abu Becr, with whom it was ſent, and who was to be his ſucceſſor. This letter Merwan took care ſhould be diſcovered: and Mahomet taking it for a genuine order of the khalif, publiſhed the ſuppoſed injury all over the neighbouring countries. He then marched with a body of rebels to Medina, where the innocent khalif was beſieged in his palace; and, notwithſtanding all his proteſtations, nothing leſs than his death could ſatisfy the enraged multitude. In this deplorable ſituation Othman ſent to Ali for aſſiſtance; who commanded his two ſons Haſan and Hoſein to defend the palace gates. This they did for ſome time with fidelity enough, till finding the khalif reduced to great ſtraits for want of water, they abandoned their poſts; upon which the rebels eaſily made themſelves maſters of the palace, and cruelly 103

murdered the khalif in the 82d year of his age, after

He is murdered.

he had reigned 12 years. His body remained three days unburied; and was at laſt thrown into a hole made for it, and without the uſual ablution, or the leaſt funeral ſolemnity.

The arms of the Moſlems had hitherto been ſo ſucceſsful, and their conqueſts ſo rapid, that they may ſeem not only to have vied with Alexander, but to have bid fairer for univerſal monarchy than any nation either before or ſince.—The ruin of mighty empires always originates from the impoſſibility of keeping them united

Arabia. united. Divisions arise; civil wars break out; and the kingdom being weakened by these intestine feuds, the common enemies take advantage of them to ruin the whole fabric.—If we consider Mahomet, as in truth he was, not as an enthusiast, but as a politician, and the founder of an empire; we shall find him in that capacity superior perhaps to any that ever existed. The empire of Alexander the Great, which arose with still more rapidity than that of the Arabs, had no support but from his own ambition and personal qualifications. While he lived, he was without a rival, because all were afraid of him; but when he died, the bands of union whereby his empire had been held together, were immediately dissolved. His captains were not inspired with the same veneration for his son, who was unborn at the time of his death, that they had for his father; and therefore they fought not to conquer for him, but for themselves; and the consequence was, that the kingdom fell to pieces the moment that he died. The same thing happened to the empires of Jenghiz Khan, Tamerlane, and others, who made vast conquests in a short time. They erected mighty empires indeed; but their duration, we may say, was but momentary. The empire of the Romans was founded on a kind of enthusiastic desire of aggrandizing the city of Rome: patriotism became fashionable; and as the city never ceased to exist, those who conquered always had the same end in view, namely to exalt the republic more and more. This empire, therefore, was not only very extensive, but very durable; though, as it was impossible that mankind could always continue to venerate a city, the same divisions that ruined other empires at last brought this to an end.—The foundation of Mahomet's empire seemed to be still more firm. He was not only the king, but, we may say, the god of his people. Whatever enthusiasm people may show in defending their country, nay even their nearest relations, experience has taught us, that it is greatly inferior to what is shown by those who fight in defence of religion. This enthusiasm Mahomet had taken care not only to bring over to his side, but to exalt to its highest pitch, by inculcating upon his followers, that their rewards in the next world should be proportionable to the fury with which they fought in this. To live at peace, except with those who submitted to his will, did not at all enter into his plan; and he who made no conquests, or at least did not strive to make them, was no true believer. By this means, let his empire be ever so much extended, the temptation to making fresh conquests was still equally strong; and not only the commanders of armies, but every private person, had the most powerful motives to urge him towards the conquest of the whole world, had that been possible.—The only thing Mahomet seems to have failed in was, the appointment of the succession to the apostleship; and why he was deficient in this is inconceivable. From this one source proceeded the divisions which ruined his empire when it was scarce erected, and of which we are now to give the history.

104 Causes of the decline of the Moslem empire

Tho' the prophet had been so deficient in providing for the safety of his kingdom as not to name a successor at his death; yet his son-in-law Ali was always of opinion that the succession belonged of right to him; and that it ought to be, like that of other kingdoms, hereditary. This disposition to render the apostleship hereditary in his family, was, in all probability, what disgusted the Moslems with Ali; against whom they could otherwise have no objection: for he was endowed with every amiable quality; a firm believer in Mahomet; and of such unparalleled strength and courage, that he never declined a combat to which he was challenged, nor ever failed to come off victorious; for which reason he was styled by his countrymen, "the Lion of God."

105 Character of Ali.

On the death of Othman, however, notwithstanding the prejudices against Ali, as none could pretend so good a right to the khalifat as he, the Arabs immediately took the oath of allegiance to him, tho' with an intention to break it as soon as possible, as was fully evinced by the event. The disturbances which happened immediately on Ali's accession were owing partly to the machinations of Ayesha, who, having got Othman murdered on purpose to raise Telha to the dignity of khalif, and now finding Ali unanimously chosen, resolved to destroy him also. She therefore pretended great concern for the death of the late khalif, and accused Ali of being his murderer: but being reproved by one of the Moslems for endeavouring to blacken an innocent person, when she could not but know herself guilty; she replied, that Othman's infidelity had indeed made her his enemy, but that she had forgiven him upon his repentance. At the time of Ali's inauguration she was at Mecca, where she enjoyed a very considerable share of influence and authority. At her instigation, Telha Ebn Obeidallah, and Zobeir Ebn Al Awam, began to represent to Ali, that the murderers of Othman ought to be brought to condign punishment; offering themselves at the same time for that purpose. This they did purely to sow dissension, for they themselves had been deeply concerned in the murder; and Ali, sufficiently aware of their intention, told them it was impossible till the empire should be more settled. Finding themselves disappointed in this attempt, they next begged the government of Cufa and Basra, that they might with the greater facility extinguish any rebellion that should happen. Here again Ali was aware of their intention; and refused their request, under pretence that he stood in need of persons of their great capacity, as counsellors, about his person. Then they desired leave to perform a pilgrimage to Mecca, which the khalif could not refuse; and they were no sooner got there, than they set about raising an army against him without any provocation at all.

106 He is chosen khalif.

107 Disturbances raised by Ayesha

This, however, was not the only source of discord at present. Ali had been displeased with the governors of provinces appointed by Othman; and therefore dismissed them immediately upon his accession. This was very impolitic; but he was prompted to it by that rashness and want of prudence which is inseparable from, or rather is the very essence of, great courage. The consequence of this was, that Moawiyah, governor of Syria, was, immediately upon his dismission by Ali, proclaimed khalif by the troops under his command.—Thus the Moslems were divided into two factions; the one under Moawiyah and Ayesha, who adhered to the house of Ommiyah, to which Othman and Moawiyah belonged; and the other to Ali. The adherents of the house of Ommiyah were called *Motazalites*, or *separatists*.

108 And Moawiyah.

Ali finding how matters were situated, and that a very strong party was formed against him, endeavoured to

109 Ali raises an army.

to ingratiate himſelf as much as poſſible with the Koreiſh; and to raiſe an army againſt Ayeſha, who had now taken the field, and even reduced the city of Baſra. He made a formal ſpeech to the people on hearing this bad news, and deſired their aſſiſtance. But though he was very much beloved on account of his perſonal merit, and the beſt orator of the age, he could not with all his eloquence for ſome time prevail on them to give a deciſive anſwer in his favor. At laſt Ziyad Ebn Hantelah ſtept to Ali of his own accord, and ſaid, "Whoſoever retreats, we will advance." Upon this two Anſars, doctors of the law, ſtood up, and pronounced Ali innocent of the death of Othman; which deciſion ſoon induced the Anſars and the body of the people to eſpouſe his quarrel. He then left Medina, with a body of 900 men, and advanced to Arrabah, where he was joined by ſeveral other parties. From this place he wrote to the people of Cufa and Medina, preſſing them to ſend him farther aſſiſtance, and to diſpoſe the Motazalites to an accommodation. From Medina he very ſoon obtained a large ſupply of horſes, arms, and other neceſſaries; and from Cufa he obtained with difficulty a reinforcement of 8000 men.

Being greatly animated by this ſeaſonable ſupply, Ali advanced towards Baſra, where the troops of Ayeſha were ready to receive him. Both parties ſeemed averſe to an engagement; and Ayeſha began to be very much intimidated at the ſight of Ali's army, which,
110 *He defeats and takes Ayeſha priſoner.*
however, was inferior to her own: but, by ſome means or other, a battle was at laſt brought about, in which, Ayeſha was defeated and taken priſoner. The only remarkable effort that was made by the troops of Ayeſha in this engagement, was in defence of her perſon. It is ſaid, that no fewer than 70 men who held her camel by the bridle, had their hands cut off ſucceſſively; and that the pavilion in which ſhe ſat was ſo full of darts and arrows, that it reſembled a porcupine. Ayeſha was treated very kindly by Ali, who at firſt ſet her at liberty, but afterwards confined her to her houſe at Medina, and commanded her to interfere no more with ſtate-affairs, though he ſtill allowed her to perform the pilgrimage to Mecca.

After this victory, Ali had no enemies to contend with either in Arabia, Irak, Egypt, Perſia, or Khoraſan. A ſtrong party, however, ſtill remained in Syria, headed by Moawiyah, who founded his claims to the khalifat on a pretended declaration of Othman that he ſhould be his ſucceſſor. In this defection he was joined by Amru Ebn Al As, who had obtained a promiſe of the government of Egypt, provided Moawiyah could be advanced to the dignity of khalif.

Ali, with his uſual good-nature, endeavoured to bring the rebels to a ſenſe of their duty, and often ſent propoſals of accommodation to Moawiyah; but he ſtill remained inflexible. Perceiving, therefore, that it would be neceſſary to invade Syria, he entered that country with an army of 70,000 men, while Moawiyah advanced to meet him with 80,000; and by repeated reinforcements Ali's army at laſt amounted to 90,000, and Moawiyah's to 120,000. The two armies came in ſight of each other towards the cloſe of the 36th year of the Hegira, when they ſeemed ready to enter upon action; but only ſome ſkirmiſhes happened between them, wherein neither party ſuſtained any conſiderable loſs. The firſt month of the 37th year was ſpent in fruitleſs negociations; but in the ſecond month they began to fight in different parties, without ever hazarding a general engagement. Theſe battles continued, according to ſome, for 40 days, and according to others, 110. Maowiyah's loſs amounted to 45,000 men, and Ali's to 25,000, among whom, were 26 who had been intimately acquainted with Mahomet himſelf, and were dignified with the title of *The Companions*. The moſt famous of theſe was Ammar Ebn Yaſer, Ali's general of horſe, who was upwards of 90 years of age, and was highly eſteemed by both parties. The loſs of this general ſo exaſperated Ali, that he charged the Syrians with a body of 12,000 men, 111
Moawiyah challenged to a ſingle combat by Ali.
broke them, and challenged Moawiyah to fight him in ſingle combat. This challenge Moawiyah declined, inſiſting that it was not a fair one, as Ali could not but be ſenſible of his ſuperiority in ſtrength. As the challenge was given in the hearing of both armies, Amru inſiſted that Moawiyah could not in honour refuſe it; but the coward made no other reply than that Amru aſpired to the khalifat himſelf, and wanted to enjoy it after his death. The battle being now renewed with great fury, Moawiyah's forces were puſhed to their camp; which had certainly been taken, had not 112
Amru's ſtratagem
Amru bethought himſelf of the following ſtratagem to retrieve Moawiyah's affairs, when he ſeemed on the very brink of deſtruction. He ordered ſome of his men to fix copies of the Koran to the points of their lances, and carry them to the front of the battle, crying out at the ſame time, "This is the book that ought to decide all differences between us; this is the book of God between us and you, that abſolutely prohibits the effuſion of the Moſlem blood."—This produced the deſired effect. The khalif's troops threw down their arms, and even threatened him with death if he did not ſound a retreat; which he therefore found himſelf obliged to do, and thus had a deciſive victory wreſted out of his hands.

According to this new mode of deciſion, the two parties were each to chooſe their arbitrator; but even this was not allowed to Ali, though Moawiyah had liberty to chooſe Amru Ebn Al As. The troops of Irak, not content with offering ſo groſs an affront to the khalif, inſiſted on naming for his arbitrator Abu Muſa Al Aſhavi; a very weak man, and one who had already betrayed him. The conſequence of this appointment 113
Ali depoſed.
was, that Ali was depoſed by both the arbitrators; and he accordingly dropt his title to the khalifat, but without laying down his arms, or putting himſelf in Moawiyah's power.

After this deciſion, Ali retired to Cufa, where he was no ſooner arrived, than 12,000 of theſe troops who had themſelves forced him to accept of the arbitration, pretending to be offended with the ſtep he had taken, revolted from him. Theſe were called *Kharejites*, that is, rebels or revolters: and *Mohakkemites*, or judiciarians, becauſe they affirmed that Ali had referred to the judgment of men what ought to have been only referred to the judgment of God; and, therefore, that inſtead of keeping the peace he had made with Moawiyah, he ought to purſue his enemies, who were likewiſe the enemies of God, without mercy. To this Ali replied, That as he had given his word, he ought to keep it: and, in ſo doing, he only followed what was preſcribed by the law of God. The Kharejites

rejites replied, That God was the only judge between him and Moawiyah, and that consequently he had committed an enormous sin, of which he ought sincerely to repent. This irritating Ali, he with some warmth replied, That if any sin had been committed on this occasion, it was by themselves, who had forced him to

114 He defeats the Kharejites.

take the steps of which they now complained. This answer not proving agreeable, they chose for their general Abdallah Ebn Waheb, who appointed for their rendezvous Naharwan, a town seated between Waset and Bagdat, about four miles to the eastward of the Tigris. Here they assembled an army of 25,000 men; and Ali, having tried gentle methods ineffectually, at last marched against them in person. Before he attacked them, however, he planted a standard without the camp, and made proclamation by sound of trumpet, that whoever would repair to it should have quarter, and whoever would retire to Cufa should find a sanctuary there. This had such an effect, that Abdallah's army was soon reduced to 4000 men, with whom he rushed upon the khalif's forces; but all of them were cut in pieces, except nine who escaped.

Had Ali marched against Moawiyah immediately after the defeat of the Kharejites, and while his troops were flushed with victory, he had probably reduced him entirely: but by allowing his troops to refresh themselves, they all deserted him, and Moawiyah's party had an opportunity of gathering still more strength; and though Moawiyah's troops often made incursions

115 They attempt to murder Ali, Amru, and Moawiyah.

into the territories of Ali, the latter seems afterwards to have acted only on the defensive. At last the Kharejites, imagining that it would be for the good of the Moslem affairs that Moawiyah, Ali, and Amru, were dead, dispatched assassins to murder all the three. Moawiyah was wounded, but recovered; Amru's secretary

116 Ali assassinated.

was killed by mistake; but Ali was wounded with a poisoned sword, which occasioned his death. The assassin was taken, and Ali would have pardoned him had he recovered, but ordered him to be put to death if he died, that he might, as he said, "have an immediate opportunity of accusing him before God." Even in this order he showed his usual clemency, as he ordered the assassin to be dispatched at one blow, and without torture of any kind.

Thus fell Ali, the most virtuous of all the Mahometan khalifs, after he had reigned near five years, and lived 63. He was pressed by those about him to nominate a successor before he died; but this he declined, saying, he would follow the example of the Apostle of God,

117 Succeeded by Hasan:

who had not named any: and, as his son Hasan inherited his father's piety, though not his courage, he was declared khalif without any scruple. Moawiyah, however, behaved in such a manner towards him, as showed his hostile intentions; and those about Hasan pressed him to declare war immediately. This Hasan, who was of an exceeding mild and peaceable disposition, could hardly be persuaded to do; and though he at last took the field, yet he immediately perceived his

118 Who resigns the khalifat to Moawiyah.

incapacity to dispute the empire with Moawiyah; and therefore resigned it, in spite of all the remonstrances of his friends, to a traitor, who caused him after some years to be poisoned by his wife.

Moawiyah being thus left sole master of the Moslem empire, found himself under a necessity of reducing the Kharejites, who were his enemies as well as Ali's, and had now gathered together a considerable army. Against these rebels the khalif would have dispatched Hasan, but that prince refused; upon which he sent the Syrian troops against them, who were defeated: however the Cufans, being at last persuaded to take up arms, soon extinguished the rebellion, and settled Moawiyah more firmly than ever on the Moslem throne.

119 Constantinople besieged without success.

In the 48th year of the Hegira, the khalif sent his son Yezid with a powerful army to besiege Constantinople. In this expedition he was attended by three or four of the *Companions*, who, notwithstanding their age, were prompted by zeal to undergo incredible fatigues. The Moslem forces too, though they suffered extremely, were animated to surmount all difficulties by a tradition, according to which the prophet in his lifetime declared, "That the sins of the first army that took the city of Cæsarea should be forgiven." Concerning the particulars of this expedition we are in the dark: only, in general, that it proved unsuccessful; and in it Abu Ayub, who had been with Mahomet at the battles of Bedr and Ohod, lost his life. His tomb is held in such veneration by the Moslems, that the Sultans of the Ottoman family gird their swords on at it on their accession to the throne. In the 54th year of the Hegira,

120 Turks defeated.

the Arabs made an irruption into Bukharia, and defeated a Turkish army that opposed them. The Turks lost a great number of men; and the queen, who commanded in person, with great difficulty made her escape. She had only time to put on one of her buskins; the other fell into the hands of the Arabs, who valued it at no less than 2000 dinars. About this time also, according to the Greek historians, a treaty was concluded between the emperor and the Moslems, whereby the latter were allowed to keep the territories they had seized; in consideration of which they were to pay 3000 pounds weight of gold, 50 slaves, and as many choice horses. To these dishonourable conditions they were obliged to submit, in consequence of their late unsuccessful expedition to Constantinople, and some other defeats they had received. This peace was to continue for 30 years. The next year, Moawiyah, having conferred the government of Khorasan upon Saad, Othman's grandson, that general, soon after his promotion, passed the Jihun, or Amu, the Oxus of the ancients, and advanced with a body of troops to Samarkand, which opened its gates to him on his approach; soon after which he defeated an army of Usbeck Tartars, and marced directly to Tarmud, or Tarmid, which also surrendered without opposition. The 57th year of the Hegira was remarkable for nothing but vast swarms of locusts, which did incredible damage in Syria and Mesopotamia; and great discontents on account of the khalif's having nominated for his successor his son Yezid, a person of scandalous life, and no way worthy of the throne. The 58th year of the Hegira was rendered remarkable by the death of

121 Moawiyah dies.

Ayesha, Mahomet's widow; and the 60th by that of Moawiyah, after having reigned, from Hasan's resignation, nineteen years three months and five days; but concerning his age authors are not agreed. He was interred at Damascus, which was made the residence of the khalifs as long as the house of Ommiyah continued on the throne.

122 Succeeded by Yezid.

Yezid was proclaimed, in consequence of his nomination, the same day his father died. His inaugura-

tion

Arabia.

tion was performed on the new moon of the month Rajeb, corresponding to April 7th, 680. Immediately after his election, he wrote to Al Walid, governor of Medina, to seize Hosein, the remaining son of Ali, and Abdallah Ebn Zobeir, in case they refused to acknowledge his right. He accordingly tendered the oath of allegiance to Hosein, who returned an evasive answer, and found means to escape to his own house. As for Abdallah, he delayed waiting upon the governor, under various pretences, for 24 hours; after which he made his escape to Mecca: hither Hosein followed him; but received an invitation from the people of Cufa, who promised to assist him in vindicating the rights of his father Ali and himself. In the mean time, Yezid, being informed of Al Walid's negligence in suffering Abdallah and Hosein to escape, removed him from his employment, appointing in his room Amru Ebn Saad, at that time commandant of Mecca. The new governor immediately dispatched against Abdallah Amer Ebn Zobeir, Abdallah's, own brother, who mortally hated him: but Abdallah, having engaged Amer in the field, defeated and took him prisoner; which greatly raised his reputation at Medina, although Hosein's superior interest among them still rendered him incapable of aspiring to the khalifat by himself.

123
Hosein and Abdallah refuse to acknowledge him.

While Abdallah was thus strengthening himself at Mecca and Medina, Hosein was doing the same at Cufa. On the first notice of their inclinations, he had sent to them Moslem Ebn Okail, to whom, as representative of the son of Ali, they had taken an oath of allegiance, and were now very pressing on Hosein to honour their city with his presence. Besides this, Hosein was supported by the forces of Irak, who retained a great veneration for the memory of his father, and had all along considered the government of Moawiyah as a downright usurpation.

Notwithstanding all these steps taken at Cufa in favour of Hosein, the deliberations of the conspirators were carried on with such secrecy, that Al Nooman the governor continued a stranger to them, even after the Cufans had determined immediately to enter upon action with an army of 18,000 men. At last, however, he began to be roused from his lethargy; but Yezid being displeased with his conduct, removed him from his government, appointing for his successor Obeidallah Ebn Ziyad. This governor entered the city in the evening, and was received with all possible demonstrations of joy by the Cufans, who mistook him for Hosein, owing to a black turban which he had on his head, resembling that which Hosein usually wore. His first care was to extinguish the sedition that had been excited by Moslem. In order to this, he commanded a trusty servant to disguise himself, and personate a stranger come out of Syria to see the inauguration of Hosein; that he might get admission into Moslem's house, and penetrate all his councils. This commission was faithfully executed; and Obeidallah understanding that Moslem lodged in the house of one Sharik, who was then sick, sent a messenger to Sharik, letting him know that he intended to visit him on a certain day. Sharik immediately came to a resolution to receive him, and appointed Moslem a place in the corner of the room whence he might rush out upon Obeidallah and kill him. The visit was accordingly made; but Moslem's heart failing him, the governor escaped: Hani, however, in whose house Moslem had first lodged, was imprisoned by Obeidallah. Upon the news of this, Moslem assembled about 4000 men, and besieged Obeidallah in the castle. The governor, however, not in the least dispirited, made a speech to Moslem's followers; which had such an effect upon them, that they all deserted him except about 30. By the favour of the night, Moslem escaped to a poor woman's cottage in the neighbourhood; but being betrayed by her son, Obeidallah sent a datachment of 80 horse to seize him. Moslem made a gallant resistance, and thrice cleared the house of them; but being at last overpowered with numbers, and grievously wounded, he was taken and brought to Cufa. While on the road, he endeavoured to send an account of his bad success to Hosein, then, as he supposed, on the road to Cufa; but without success. When arrived at the castle he begged a draught of water: but those who stood by told him he should have none till he drank the hamim, or boiling liquor, which the Mahometans pretend is drunk by the damned in hell; and soon after this, being brought before the governor, he was beheaded along with Hani, and both their heads sent as a present to Yezid.

Hosein, in the mean time, was preparing to set out for Cufa, having received the most favourable advices from Moslem, of whose fate he was ignorant, and who had sent him a list of 140,000 men that were ready to obey his orders. This the wisest of his friends represented as a desperate enterprize, and intreated him to drop it, or at least to defer his journey till he should be better assured of success: but Hosein was deaf to all salutary counsel; nay, he could not, by the most earnest intreaties, be prevailed upon to forbear taking his wives and children along with him. The consequences of this obstinacy may easily be imagined: Obeidallah dispatched first 1000, and then 5000 men against him; with orders, however, not to offer any violence to him, provided he submitted himself. To these terms the infatuated Hosein would not agree: he offered indeed to return home, if Obeidallah would permit; but that not being granted, he desperately engaged the troops of Obeidallah, and was after long resistance cut in pieces with all his men. His head was brought to Obeidallah, who struck it over the mouth with a stick, and treated it with great contempt. He was also inclined to have put his family to death; but probably feared an insurrection, as the people of Cufa expressed great resentment on account of Hosein's death; nor was it at all agreeable to the khalif Yezid, who treated the family of the unfortunate Hosein with the greatest kindness.

124
Hosein's obstinacy.

125
He is defeated and killed.

This year, the 61st of the Hegira, Yezid appointed Salem Ebn Ziyad governor of Khorasan; who, soon after entering upon the government, made an irruption into the Turkish territories. He took his wife along with him in this expedition, who was delivered of a child in the neighbourhood of Samarcand; on which occasion she is said to have borrowed some jewels from the prince of Sogd's lady, which she afterwards carried off with her. In the mean time Salem detached Mohalleb with a considerable body of troops to Khowarazm, the principal city of the Turks or Tartars in those parts, from which he extorted the immense sum of 50,000,000 pieces of money; from whence advancing

to

to Samarcand, he forced the inhabitants of that city alſo to pay him an immenſe ſum; and then retired, with little loſs, into the province he governed.

In the mean time Abdallah Ebn Zobier, finding himſelf, by the death of Hoſein, at the head of the partizans of the houſe of Haſhem, who were greatly oppreſſed by Yezid, began in earneſt to aſpire to the khalifat. As he had therefore never owned the authority of Yezid, he now openly declared againſt him,

126 Abdallah proclaimed khalif.

and was proclaimed khalif at Medina ſoon after the arrival of Hoſein's family in that place. Soon after his inauguration, to render himſelf the more popular, he expatiated on the circumſtances of Hoſein's death, which indeed were very tragical, and repreſented the Cufans as the moſt abandoned and perfidious villains upon earth. This went ſo well down with the citizens of Mecca and Medina, that they flocked to him in great numbers, ſo that he ſoon found himſelf at the head of a conſiderable force. The khalif Yezid being informed of his progreſs, ſwore he would have him in chains; and accordingly ſent a ſilver collar for him to Merwan, then governor of Medina: but the intereſt of Abdallah was now ſo ſtrong, that he laughed at the menaces both of the khalif and Merwan. Nay, the governor of Mecca, though he ſecretly hated him, thought it good policy, as matters then ſtood, to keep up a good underſtanding with Abdallah: but this coming to the ears of Yezid, he depoſed the governor; appointing in his place Walid Ebn Otbah, a man of known fidelity, and a bitter enemy of Abdallah. The new governor, therefore, immediately on his acceſſion, uſed all his art and ſkill to circumvent Abdallah; but to no purpoſe, as the latter was always on his guard. This conduct, however, giving him great diſguſt, as well as terrible apprehenſions, he wrote to the khalif, informing him that all the diſturbances were owing to the untractable diſpoſition of Walid; and that, if he would ſend a perſon of a different character, peace would ſoon be reſtored. This letter the khalif very injudiciouſly gave ear to, and diſmiſſed his faithful governor, appointing in his room one who was totally unqualified for that poſt. The people of Medina, now

127 Yezid formally depoſed.

having freſh intelligence of Yezid's diſſolute manner of life, renounced their allegiance to him, and formally depoſed him in a very ſingular manner. After they had aſſembled in the moſque, about the pulpit there, one of them ſaid, "I lay aſide Yezid as I do this turbant," and immediately threw his turbant on the ground. Another ſaid, "I put away Yezid as I do this ſhoe," caſting away his ſhoe at the ſame time. Theſe examples being followed by others, there was a large heap of ſhoes and turbants almoſt inſtantly formed upon the ſpot. They then diſmiſſed Yezid's governor, and baniſhed from the city all the friends and dependents of the houſe of Ommiyah. Theſe, to the number of about 1000, took refuge in the houſe of Merwan Ebn Al Hakem, where they were ſo cloſely beſieged by Abdallah's party, that they found themſelves obliged to ſend to Yezid for immediate aſſiſtance; acquainting him, that if they were not ſuccoured, they muſt all inevitably periſh. The khalif, though he wondered that ſuch a number of men ſhould ſuffer themſelves to be ſo cooped up without making the leaſt reſiſtance, diſpatched Moſlem Ebn Okba to Medina, with a conſiderable body of troops, to quell the diſturbances. He ordered him to ſpare Ali the ſon of Hoſein and his family, as they had no hand at all in the diſturbances: then he was to ſummon the town of Medina to ſurrender for three days ſucceſſively; which if they refuſed, he was to take it by ſtorm, and give it up to be plundered by the ſoldiers for three whole days.

The inhabitants of Medina being now ſenſible of their danger, ſuffered the friends of the houſe of Ommiyah to withdraw quietly out of the city; though, before they departed, a promiſe was extorted from them not to appear in arms againſt the reigning faction. Moſlem, in the mean time, advanced towards the city at the head of 5000 foot and 12,000 horſe; and having ſummoned it according to his inſtructions, upon its refuſal made the neceſſary preparations for an attack. The garriſon, however, for a conſiderable time, made a vigorous defence; but at laſt, moſt of the Anſars and principal officers being killed, the Arabs propoſed a capitulation. Moſlem, however, would hearken to no terms, and inſiſted on their ſurrendering at diſcretion; which being refuſed, he entered the city after a faint reſiſtance. Ali was treated with great reſpect; but all the men that had carried arms were put to the ſword, and Moſlem ſuffered his troops to raviſh 1000 women, and to pillage the city for three days ſucceſſively. Thoſe that eſcaped the ſlaughter he forced to acknowledge themſelves the ſlaves and vaſſals of Yezid. For this extreme ſeverity he was ſurnamed by the Arabs *Al Muſrif*, or *The Extravagant*, and ever after conſidered as an impious perſon, eſpecially as the prophet had declared that the wrath of God ſhould moſt certainly remain upon thoſe who ſacked or plundered the city of Medina.

128 Medina taken and plundered by the khaliff's forces.

After the reduction of Medina, Moſlem directed his courſe to Mecca, where Abdallah then reſided; but he died by the way, and the command of the troops devolved upon Hoſein Ebn Thamir Al Selwi. This general advanced to Mecca, which he beſieged for 40 days, battering the town with ſuch fury, that he beat down a great part of the famous temple there, and burnt the reſt; nor would the city itſelf have eſcaped the ſame fate, had not an end been put to the war by the arrival of certain accounts of the death of Yezid, who departed this life in the 64th year of the Hegira, anſwering to the year 684 of the Chriſtian æra, having lived 39, and reigned three years and ſix or eight months. On the news of his death, Hoſein offered to take the oath of allegiance to Abdallah; but the latter at that time durſt not truſt him, of which he had afterwards ſufficient reaſon to repent.

129 Yezid dies.

Yezid was ſucceeded by his ſon Moawiyah II. who was proclaimed khalif at Damaſcus the ſame day that his father died; but being of a weakly conſtitution, and unable to bear the fatigues of government; reſigned the crown ſix weeks after his inauguration, and died ſoon after without naming a ſucceſſor.

130 Moawiyah II. proclaimed khalif and reſigns.

This abdication having left the Moſlem empire abſolutely without a maſter, great commotions enſued. On the death of Yezid, Obeidallah Ebn Ziyad, governor of Baſrah, repreſented to the citizens that they ought to chooſe a protector till a new khalif ſhould be choſen; and if the perſon ſo choſen ſhould be diſagreeable

able to them, they might then remain in a state of independency under the protector whom they had chosen. The inhabitants, perceiving the drift of this speech, complimented him with that honour; which he accepted with seeming difficulty; but sending a deputy to Cufa, the inhabitants of that city not only refused to acknowledge his authority, but threw dust and gravel at his messenger. This coming to the ears of the people of Basrah, they not only deprived Obeidallah of the dignity they had newly conferred upon him, but even expelled him the city. Nor could he prevail upon the Najari, a tribe of Ansars, to espouse his quarrel, nor even upon his own relations, though he distributed among them great part of the sixteen millions of pieces of money which he had found in the treasury of Basrah, and kept the remainder to himself. Nay, so odious had he rendered himself to all ranks, an account of his cruelties, particularly the death of Hosein the son of Ali, that his brother Abdallah was unable to protect him from the fury of the populace, though he kept him concealed in womens clothes, and distributed among the mob 200,000 pieces of money. He was therefore at last constrained to leave the city, attended by a guard of 100 men. Immediately after his departure, the mob plundered his house, and pursued him, so that he was obliged to exchange his camel for an ass, and thus with the utmost difficulty escaped into Syria.

131 Obeidallah forced to fly into Syria.

In the mean time, Hosein Ebn Thamir, being returned into Syria with the forces under his command, gave a faithful account of the situation of affairs in Arabia to Merwan Ebn Al Hakem. He also acquainted him of the offer he had made to Abdallah of the oath of allegiance, which the latter had refused, or at least would not come to Damascus in order to be invested with the supreme authority there. On this account he advised Merwan to take care of himself and the rest of the house of Ommiyah, who had fled to Damascus after their expulsion from Medina. On this discourse Merwan was inclined to submit to Abdallah; but was diverted from it by Obeidallah, who insisted that no superior ought to be acknowledged by Merwan, who was at the head of the Koreish. The people of Damascus had constituted Dahak Ebn Kais their protector, who inclined to Abdallah The Basrans were at this juncture entirely in tumult and confusion, not being able to agree about a protector after the expulsion of Obeidallah; so that at last they wrote to Abdallah, offering him the government of their territory. This he accepted, but could not be prevailed upon to stir from Mecca: nor could Merwan be persuaded to suffer any of the Syrians to perform the pilgrimage to Mecca, lest they should join Abdallah, and thereby contribute to his exclusion from the throne.

132 Merwan proclaimed khalif at Damascus.

In the midst of this confusion Abdallah might have easily secured the khalifat to himself, had he not with the utmost imprudence as well as inhumanity given orders for the extermination of the house of Ommiyah. This ruined his affairs; for they being now obliged to provide for their own safety, Merwan was proclaimed khalif at Damascus; and thus the whole Moslem empire was rent into two potent factions, the one under Merwan, and the other under Abdallah.

We have already observed, that Dahak Ebn Kais inclined to favour Abdallah. This he continued to do after Merwan was proclaimed khalif, insomuch that a battle soon ensued between his followers and those of Merwan, in which Dahak was defeated and killed; and thus Merwan became master of all the province of Syria. Soon after this victory, Merwan advanced with a considerable body of troops towards Egypt; but sent before him Amru Ebn Saad with a detachment, in order to facilitate his passage. That general having defeated Abdalrahman, Abdallah's lieutenant, in several brisk actions, he at last surrendered the whole country to Merwan for a sum of money, and retired with the Arabs under his command to Hejaz. The Syrian troops, therefore, immediately took possession of that country, and obliged the inhabitants to take an oath of allegiance to Merwan; who having appointed his son Abdalazziz to preside over Egypt, returned with the greatest part of his forces to Damascus. Here he was informed that Abdallah had dispatched against him his brother Musab with a considerable army. Against him Merwan dispatched Amru Ebn Saad; who having soon come up with him, gave him a total defeat, and dispersed his troops in such a manner that Musab found it impossible to rally them again.

133 Abdallah's forces defeated by Merwan.

134 The Cufans revolt.

In the 65th year of the Hegira, the inhabitants of Cufa, pretending to be seized with remorse of conscience for their treachery to Hosein the son of Ali, raised an insurrection against both the khalifs, and therefore assembled a body of 16,000 men, under the command of one Soliman, who was to revenge the death of Hosein upon Obeidallah Ebn Ziyad and his adherents. But while Soliman and his troops remained yet inactive, Al Mockhtar, who had served under Abdallah, and was disgusted at not having been promoted as he expected, arrived at Cufa, and representing the incapacity of Soliman, who indeed appears to have been totally unfit for such an enterprize, offered to take the command upon himself. This, however, was refused; and as Al Mockhtar had no opinion of Soliman's military capacity, he found means to draw off 2000 of his troops; while 10,000 more chose rather to violate the oaths they had taken, that run the risk of being cut to pieces by a superior enemy. Soliman, however, put a good face upon the matter; and, telling his troops that they were to fight for another world and not this, set forward to invade Syria with the 4000 who remained with him: but being advanced as far as Eksas upon the Euphrates, he found that he had lost 1000 men by desertion; nor was he joined by the Separatists of Basrah and Al Madayen, though they had promised him a reinforcement. Firmly persuaded, however, that his cause was the cause of heaven, Soliman continued his march all night, and next day arrived at the tomb of Hosein, where his men performed their devotions with such enthusiasm of penitence, that one present swore he never saw such crowding about the black stone in the temple of Mecca itself.—Continuing still to advance, he received a friendly letter from Abdallah Ebn Yezid, the governor of Cufa, advising him to return, and representing to him the folly of engaging so powerful an army as would be sent against him, with an handful of men: but Soliman, imagining that he was only recalled in order to support Abdallah Ebn Zobeir in his pretensions to the khalfat, persisted in

135 Joined by Al Mockhtar.

136 Soliman's folly and enthusiasm.

Arabia. in his resolution of penetrating into Syria. He told his troops, that they would never be nearer the two Hoseins (Hosein, and his brother Hasan, to whom also the Shiites give that name) than they were at present; and that should they at this time meet with death, they would be in a state of repentance, and consequently could never die in a more proper time; and after

137 He is cut in pieces with all his men. this speech, continuing still to advance, he was at last met by Obeidallah at the head of 20,000 horse, who, after an obstinate engagement, cut to pieces Soliman and all his troops.

138 Merwin dies. Soon after this decisive action died the khalif Merwan, after he had reigned eleven months. He is said by some authors to have been poisoned by his wife Zeinab, Moawiyah's widow. Her he had married, with a promise that her son Khaled should succeed him; but afterwards altering the succession in favour of his own son Abdalmalec, young Khaled reproached him with his breach of promise: upon this Merwan calling him *bastard*, the child complained to his mother, who, to be revenged for this affront, is said to have poisoned him, or smothered him in a pillow.

In the beginning of the khalifat of Abdalmalec, Al Mokhtar, who had been imprisoned by the governor of Cufa, was released at the intercession of Abdallah Ebn Omar, who had married his sister. The year following, having put himself at the head of the Shiite sectaries, he sent proposals of alliance to Abdallah Ebn Zobeir; but he, justly suspecting his sincerity, by a stratagem cut off near 3000 of his men. Upon this disaster, Al Mokhtar, fearing the house of Ali might be intimidated, sent a letter to Mahomet Ebn Hanifyah,

139 Narrow escape of the family of Ali. one of that family, in which he offered his assistance with a powerful army. This offer Mahomet declined, declaring himself only for pacific measures; but though he and all the rest of Ali's family behaved in the most peaceable manner, Abdallah did not think himself safe till they owned his authority. He therefore imprisoned them, together with 17 of the principal citizens of Cufa, whom he threatened to put to death, and afterwards burn their bodies, if they did not within a limited time take an oath of allegiance to him. Al Mokhtar being informed of the distressed situation they were in, sent a body of 750 horse to Mecca, under Abu Abdallah, to release them. That general not only executed his orders with great bravery, but took Abdallah himself prisoner, whom he would have cut to pieces on the spot, had he not been released at the intercession of Mahomet, who for the present adjusted the differences to the mutual satisfaction of all parties. After this reconciliation, Abu Abdallah, or rather Mahomet himself, distributed among 4000 of Ali's friends a sum of money brought for that purpose, in order to indemnify them for the losses they had sustained. Thus the friends of Ali were happily delivered, when only two days of time granted them by Abdallah remained, and a sufficient quantity of wood and other combustibles was collected, in order to consume their bodies. Notwithstanding the reconciliation, however, that had lately taken place, Mahomet Ebn Hanifyah thought proper to post himself on a mountain near Mecca with a body of 4000 men.

The Cufans having received advice before Merwan's death, that he had sent Obeidallah with a powerful army towards their city, and even given him permission to plunder it in case it should be taken, appointed Yezid Ebn Ares, a man of undaunted courage, to oppose him; but Merwan dying before Obeidallah could execute his commission, an end was put for the present to this expedition. The memory of it, however, still remained; and Al Mokhtar, to whom Obeidallah was personally obnoxious, assembled a body of troops to act offensively against him, and even against the Syrian 140

khalif himself, in case he would support Obeidallah. Among other preparations for their enterprize, Al Mokhtar caused a kind of portable throne to be made, telling his troops, that "it would be of the same use to them that the ark was to the children of Israel." It was therefore carried on a mule before the troops that were to march against Obeidallah, and the following prayer said before it: "O God! grant that we may live long in thy obedience; help us; and do not forget us, but protect us." This expedient was so well adapted to the hot-headed enthusiasts who composed 141 Impiety of Al Mokhtar.

Al Mokhtar's army, that they attacked Obeidallah's camp, defeated him, and gained a complete victory. Obeidallah himself was killed in the action, his head sent to Al Mockhtar, and his body reduced to ashes.— By this victory the sectaries were rendered so formidable, that Nisibin or Nisibis, and several other cities, surrendered to them without opposition. They now began to entertain thoughts of deposing both the khalifs, and placing on the Moslem throne one of the family of Ali; but all their towering hopes were soon frustrated by the defeat and death of Al Mokhtar by 142 Obeidallah defeated and killed.

Musab brother to Abdallah Ebn Zobeir. Al Mokhtar, after being defeated in a general engagement by Musab, fled to the castle of Cufa, where he defended himself with great bravery for some time; but being at last killed, his men, to the number of 7000, surrendered at discretion, and were all of them put to the sword on account of the outrages they had committed. Al Mokhtar defeated and killed by Musab.

The next year, the 68th of the Hegira, the Azarakites, so denominated from Nafe Ebn Al Azarak, the author of their sect, having assembled a considerable force, made an irruption into Irak. They advanced 143

almost to the gates of Cufa, and penetrated to Al Madayen. Being sworn enemies of the house of Ommiyah, and acknowledging no government spiritual or temporal, they committed terrible ravages in every part of the Moslem territories through which they passed. Horrid cruelties committed by the Azarakites.

They carried their excesses to such a height as to murder all the people they met with, to rip open women with child, and commit every species of cruelty that could be invented upon the inhabitants without distinction. The governor of Mawsel and Mesopotamia, being informed of these unparalleled outrages, marched against them with a body of troops, and carried on a brisk war with them for eight months. During this period their leader Nafe Ebn Al Azarak died; and was succeeded by Katri Ebn Al Fojat, under whose conduct they continued their depredations. Musab not being pleased with his lieutenant's management of the war, recalled him, and sent in his place one Omar Ebn 144

Abdallah Temimi, who gave the Azarakites a great overthrow at Naisabur in Khorasan, put many of them to the sword, and pursued the rest as far as Ispahan and the province of Kerman. Here having received a reinforcement, they returned into the province of Ahwaz, and did incredible damage to the country through They are defeated and dispersed.

Arabia. through which they passed. But Omar advancing against them a second time, they retired at his approach to Al Madayen, ravaging the district belonging to the city in a dreadful manner. However, Omar pursuing them thither also, they fled into the province of Kerman, and thence gradually dispersed themselves. This year there was a grievous famine in Syria, which suspended all military operations.

The next year, being the 69th of the Hegira, Abdalmalec left Damascus to march against Musab. In his absence he left Amru Ebn Saad governor of the city; but he immediately seized upon it for himself, which obliged the khalif to return. After several skirmishes had happened between some detachments of the khalif's troops with those of Amru, a pacification was

145 Barbarity of Abdalmalec.

concluded at the intercession of the women: but Abdalmalec barbarously put Amru to death with his own hand, notwithstanding his promise; and was immediately seized with such a tremor, that he lost the use of almost all his faculties, and was obliged to be laid in bed. In the mean time the palace was attacked by Yahyah, Amru's brother, at the head of 1000 slaves. After a warm dispute, they forced open the gates, killed several of the guards, and were upon the point of entering the palace, when the people within threw Amru's head among them. This so cooled their ardour, that they desisted from the attempt; and some money having been afterwards distributed among them, they retired. So great, however, was Abdalmalec's avarice, that after the tumult was appeased, he recalled all the money which had been distributed, and commanded it to be deposited in the public treasury.

146 Disgraceful treaty with the Greeks.

In the 70th year of the Hegira, the Greeks made an irruption into Syria; and Abdalmalec having occasion for all his forces to act against Abdallah Ebn Zobeir, was obliged to pay a tribute of 1000 dinars per day, according to Theophanes, and send every year 365 slaves and as many horses to Constantinople. In this treaty it was also stipulated, that the revenues of Cyprus, Armenia, and Heria, should be equally divided between the khalif and the Greek emperor.

147 Musab defeated and killed by Abdalmalec.

Abdalmalec being now at leisure to pursue his intended expedition against Musab, marched against him in person; and having arrived at Masken, a small town on the frontiers of Mesopotamia, where he was waited for by Musab, the latter was defeated through the treachery of the troops, and himself killed. After the battle, Abdalmalec repaired to Cufa, where he was received with the utmost submission; and people of all ranks came in crowds to take the oath of allegiance to him. He then ordered vast sums of money to be distributed among them, and gave a splendid entertainment to his new subjects, to which even the meanest of them were not refused admittance. During this entertainment, the unfortunate Musab's head was presented to the khalif; upon which one of the company took occasion to say to him, "I saw Hosein's head in this same castle presented to Obeidallah; Obeidallah's to Al Mokhtar; Al Mokhtar's to Musab; and now at last Musab's to yourself." This observation so affected the khalif, that, either to avert the ill omen, or from some other motive, he ordered the castle to be immediately demolished. Abdallah Ebn Zobeir, in the mean time, having received the melancholy news of the defeat and death of his brother, assembled the people of Mecca, and from the pulpit made a speech suitable to the occasion. He also did his utmost to put Mecca in a proper posture of defence, expecting a speedy visit from his formidable competitor, who now gave law to Irak, Syria, and Egypt, without controul.

Soon after Abdalmalec's return to Damascus, he appointed his brother Bashar governor of Cufa; and Khaled Ebn Abdallah governor of Basra. The latter had no sooner entered upon his office, than he indiscreetly removed from the command of the army Al Mohalleb, one of the greatest generals of the age; appointing in his room Abdalaziz, who was greatly his inferior in military skill. Of this dismission the Azarakites being informed, they immediately attacked Abdalaziz, entirely defeated him, and took his wife prisoner. A dispute arising among the victors about the price of that lady, one of them, to end it immediately cut off her head. Upon this disaster, Khaled was commanded to replace Al Mohalleb, which he did; and having in conjunction with him attacked the Azarakites, forced their camp, and entirely defeated them.

148 Azarakites defeated.

In the 72d year of the Hegira, Abdalmalec having no enemy to contend with but Abdallah Ebn Zobeir, made great preparations for an invasion of Hejaz, giving the command of the army to be employed on this occasion to Al Hejaj, one of his most warlike and eloquent captains. Before that general had put his army in march for Mecca, he offered his protection to all the Arabs there that would accept of it. Abdallah being informed of the enemy's approach, sent out several parties of horse to reconnoitre, and give him intelligence of their motions. Between these and some of Al Hejaj's advanced guards several skirmishes happened, in which Abdallah's men had generally the worst. This encouraged Al Hejaj to send to the khalif for a reinforcement, his troops amounting to no more than 2000 men, who were insufficient for reducing Mecca. He assured him at the same time, that Abdallah's fierceness was very much abated, and that his men deserted to him daily. The khalif, upon this, ordered a reinforcement of 5000 men under the command of Tharik Ebn

149 Mecca besieged by Al Hejaj.

Amer; but notwithstanding this additional strength, he made but little progress in the siege for some time. While he battered the temple of Mecca with his machines, it thundered and lightened so dreadfully, that the Syrians were struck with terror, and refused to play any longer upon that edifice. Upon this Al Hejaj stuck the corner of his vest into his girdle, and putting into it one of the stones that was to be discharged out of the catapults, slang it into the town, and this occasioned the recommencement of the operations. The next morning the Syrians were annoyed by fresh storms, which killed 12 men, and quite dispirited them. Al Hejaj, however, animated them, by observing that he was a son of Tehama; that this was the storm of Tehama, and that their adversaries suffered as much as they. The day following some of Abdallah's men were killed by a very violent storm, which gave Al Hejaj a farther opportunity of animating his troops. At last, Abdallah having been deserted by most of his friends, 10,000 of the inhabitants of Mecca, and even by his own sons Hamza and Khobeib, desired to know his mother's sentiments as to what course he was to take. He represented to her, that he was almost entirely abandoned by his subjects and relations; that the few who

Arabia.

who perſiſted in their fidelity to him could ſcarce enable him to defend the city any longer; and that the Syrian khalif would grant him any terms he ſhould think fit to demand. His mother, however, being of an inflexible reſolution, and not able to bear the thoughts of ſeeing her ſon reduced to the rank of a private perſon, being herſelf the daughter of Abu Becr the firſt khalif, adviſed him by no means to ſurvive the ſovereignty, of which he was on the point of being deprived. This advice being agreeable to his own ſentiments, he reſolved to die in defence of the place. In purſuance of this reſolution, he defended the city, to the amazement of the beſiegers, for ten days, though deſtitute of arms, troops, and fortifications. At laſt, having taken a final leave of his mother, and being animated by deſpair, he made a ſally upon the enemy, deſtroyed a great number of them with his own hand, and was at length killed fighting valiantly upon the ſpot. At the laſt interview he had with his mother, ſhe is ſaid to have deſired him to put off a coat of mail he had on for his defence; and, in order to inſpire him with the greater fortitude, ſhe gave him a draught in which a whole pound of muſk had been infuſed. Al Hejaj ordered his head to be cut off, and his body to be affixed to a croſs; and by reaſon of the muſk he had drank, the body emitted a grateful odour for ſeveral days.

150 Abdallah killed.

By the reduction of Mecca, and the death of Abdalla Ebn Zobeir, Abdalmalec remained ſole maſter of the Moſlem empire; but he ſuſtained a great loſs next year, in having an army of 100,000 men totally cut off by the Khazarians in Armenia. The governor, however, having marched in perſon againſt them at the head of only 40,000 men, but all choſen troops, penetrated into the heart of Armenia, defeated and diſperſed a large body of the Khazarians, drove them into their temples, and reduced them to aſhes. One of his generals alſo defeated an army of 80,000 Khazarians at the Iron or Caſpian gates, and deſtroyed a great number of them, obliging the reſt to embrace the Mahometan religion.

151 Khazarians reduced.

152 Cruelty of Al Hejaj.

Al Hejaj, in conſequence of his ſervices, was made governor, firſt of Medina, and then of Irak, Khoraſan, and Sijiſtan; in all which places he behaved with the greateſt cruelty. Having entered the city of Cufa muffled up in his turbant, he was ſurrounded by crowds of people who preſſed forward to ſee him. He told them their curioſity would ſoon be gratified; which he effectually did, by aſcending the pulpit, and treating them in a very coarſe manner; ſwearing that he would make the wicked bear his own burden, and fit him with his own ſhoe; and telling them, among other things, that "he imagined he ſaw the *heads* of men ripe and ready to be gathered, and turbants and beards beſprinkled with blood." At Baſra he made a ſpeech much to the ſame purpoſe; and, to give the inhabitants a taſte of his diſcipline, cauſed one of them who had been informed againſt as a rebel to be beheaded on the ſpot without any trial. So great indeed was the abhorrence in which he was held by thoſe over whom he preſided, that having once recommended himſelf to the prayers of a religious Moſlem, the latter inſtantly prayed, that it would pleaſe God to kill Al Hejaj quickly; "for nothing, ſaid he, could be more advantageous for himſelf or the people." In conſequence of theſe cruelties, rebellions were ſoon raiſed againſt him; but they were eaſily ſuppreſſed, and Al Hejaj continued in the full enjoyment of all his employments till he died.

Arabia.

153 Saleh and Shebib rebel.

In the 76th year of the Hegira, one Saleh Ebn Marj, a hot-headed enthuſiaſt, and Shebib Ebn Zeid, a Kharejite, took up arms againſt the khalif. They had conſpired againſt him the year before when on a pilgrimage to Mecca; and Al Hejaj had been ordered to ſeize them: but at that time they found means to make their eſcape; and having now aſſembled about 120 men, Saleh was proclaimed emperor of the faithful at Daras in Meſopotamia. The governor ſoon received intelligence of their motions; and ordered a body of 500 men, under the command of one Adi, to march againſt them: but that general, being afraid to attack them notwithſtanding his ſuperiority in numbers, demanded a reinforcement. He therefore was ſupplied with 500 more troops, with which he advanced to Daras: but being ſtill afraid of the rebels, he entered into negociations with them; during which they attacked him, entirely defeated his army, and made themſelves maſters of his camp. Upon this the governor ſent a detachment of 1500 horſe againſt them; but the rebels, notwithſtanding the ſmallneſs of their number, defended themſelves in ſuch a manner, that the khalif's troops were forced to diſmount and fight on foot. The engagement continued till night; when the rebels, finding themſelves unable to contend with ſuch numbers, retired to Mawſel. After this, Al Hejaj being informed that they had taken poſt at Daſcara, ſent againſt them an army of 5000 men. The rebels, hearing of this formidable army, abandoned their camp; but were ſo cloſely purſued, that they found themſelves obliged to ſtand an engagement at Modbaj, a ſmall village on the Tigris. Saleh's forces, conſiſting only of three companies of 30 men each, were ſoon thrown into diſorder, and himſelf killed: but Shebib made an excellent retreat to a neighbouring caſtle; from whence he ſallied out at midnight on the khalif's forces, penetrated to the very heart of the camp, where he wounded the general himſelf, and diſperſed the greateſt part of his army.

154 Their bravery.

155 Saleh killed.

156 Al Hejaj defeated by Shebib.

After this victory, the rebels became terrible even to Al Hejaj himſelf, whom they afterwards defeated in ſeveral engagements; and taking advantage of his being at Baſra, made themſelves maſters of Cufa with little oppoſition. Al Hejaj was now conſtrained to write to the khalif for a ſtrong detachment of the Syrian troops, with which he advanced againſt Shebib; whoſe army bearing no proportion to that of Al Hejaj, the former was totally defeated, had his wife's brother killed in the action, and was obliged to fly into Kerman. Having refreſhed his men in this province, he again advanced to Ahwaz, where he was met by one of Al Hejaj's generals at the head of the Syrian army. Shebib defended himſelf with incredible valour, and ſeveral times repulſed the khalif's forces; but being overpowered by numbers, as his army conſiſted of no more than 600 men, he was at laſt put to flight, and in paſſing a bridge, was thrown off by his horſe and drowned. His body was drawn up by a net, and the head ſent to Al Hejaj, who was not a little pleaſed at the ſight. After his death, the rebels quarrelled among themſelves, ſo that the khalif's troops cut off the greateſt part of them. The remainder, under Katri Ebn Fojat, fled to Tabreſtan. Here they were kind-

157 Shebib's valour and death.

Arabia.

ly received by Afhid the king, who had affigned them part of his territories for their habitation. But they had not been long fettled before they infifted upon Afhid's either embracing Mahometanifm, or paying them an annual tribute; which he refufing, they drove him into Irak, where he implored the khalif's protection. Afhid afterwards conducted a body of Moflem troops into Tabreftan; where they fell upon the rebels with fuch fury, that they killed Katri himfelf, cut a great number of his men to pieces, and took all the reft prifoners.

158 Ingratitude of the rebels.

159 They are all deftroyed.

This year alfo (the 76th of the Hegira) money was firft coined in Arabia. Before this time, the dinars, or gold coins, had Greek infcriptions; and the dirhems, or filver ones, Perfic infcriptions. The firft erection of a mint in Arabia was occafioned by the following accident. Abdalmalec added to the letters he wrote to the Greek emperor this fhort paffage of the Koran, "Say God is one;" or "Say, there is one God;" and then inferted the year of the Hegira, with the name of the prophet, in fuch a manner as gave the emperor great offence. Upon this he wrote to Abdalmalec, defiring him to alter that manner of writing, or he would fend him fome coins in which the name of Mahomet fhould be mentioned in fuch a manner as would not prove very agreeable. Abdalmalec now refolved to coin money of his own; and accordingly fome dirhems were this year ftamped by Al Hejaj, with the infcription *Alla Samad*, "God is eternal;" which gave great offence to the fuperftitious Moflems, as they imagined that the name of God would be thereby profaned by the touch of unclean perfons.

160 Money firft coined in Arabia.

In the 77th year of the Hegira, the Arabs made an incurfion into the imperial territories, and had Lazica and Bernucium betrayed to them; and the next year they made themfelves mafters of Africa Propria, demolifhing the city of Carthage fo effectually, that fcarce a veftige of it was left. They were foon driven out, however, by John the Patrician, a man of great valour and experience in war; but returning with a fuperior force, they obliged John in his turn to fly to Conftantinople.

161 Carthage demolifhed

The 79th year of the Hegira is remarkable for nothing but the rebellion of Abdalrahman in Perfia; who drove the Khakan, or emperor of the Turks, Tartars, or Moguls, out of that country: but the following year, one of the Greek generals named *Heraclius* penetrated into Syria as far as Samofata, and deftroyed 200,000 Arabs, ravaging the country in a terrible manner; and Abdalrahman was defeated and killed by Al Hejaj, after a great number of engagements, fome fay 81, and others 100. In the 83d year of the Hegira, the nobility of Armenia revolting, drove the Arabs out of that province; but Mahomet, one of the khalif's generals, entering the country with a powerful army, got the authors of the revolt into his hands, and caufed them all to be burnt alive. Encouraged by this fuccefs, the Moflems invaded Cilicia under one Azar; but were, to the number of 10,000, cut in pieces by Heraclius; and the next year, having again entered that country, 12,000 of them were deftroyed by the fame general, and the reft forced to fly into their own country.

162 200,000 Arabs deftroyed by Heraclius.

In the 86th year of the Hegira died the khalif Abdalmalec, after a reign of 21 years. He is faid to have had fuch a ftinking breath, that the flies which accidentally fettled on his lips were almoft inftantly ftruck dead by it. He was fucceeded by Al Walid, who greatly extended the Moflem dominions. The firft year of his reign, one of his generals having paffed the Oxus (now the Jihum), defeated a numerous army of Turks and Tartars. He then over-ran and entirely reduced the countries of Sogd or Sogdiana, Bagrafs, Shafh, Targana, and the whole immenfe tract going under the name of Mawaralnahr, or Great Buckharia. He alfo conquered the khan of Khowarazm, obliging him to pay an annual tribute of two millions of dinars. About the fame time another general called *Mahomet* made an irruption into India, and fubdued a confiderable part of that country. He alfo entirely fubdued the kingdom of Al Sind, lying between Perfia and India. In this expedition, Derar king of Al Sind was defeated and killed, and had his head cut off by Mahomet.

163 Abdalmalec dies.

164 Prodigious conquefts of the Moflems.

In the 90th year of the Hegira, the Moflems made an irruption into Capadocia, defeated the emperor's army who oppofed them, and took the city of Tyana. The next year they made another incurfion into the imperial territories, whence they carried off vaft numbers of flaves; and the year following one Othman penetrated into the heart of Cilicia, where he made himfelf mafter of feveral cities, but does not appear to have long kept his conquefts.

In the 93d year of the Hegira, anfwering to that of Chrift 712, Tarek Ebn Zarka made a defcent into Spain, defeated Roderic the laft king of the Goths, reduced the city of Toledo, and over-ran a confiderable part of the kingdom. Being afterwards joined by Mufa, commander of the African Moflems, the two generals made themfelves mafters of moft of the fortreffes, fubjugating in a manner the whole country, and obliging it to pay tribute to the khalif. In thefe expeditions the Moflems acquired fpoils of immenfe value; and, amongft other things, an exceeding rich table, called by the Arab writers "the table of Solomon the fon of David." According to thefe writers, this table confifted entirely of gold and filver, and was adorned with three borders of pearls; but Roderic of Toledo, a Spanifh hiftorian, fays it confifted of one entire ftone, of a green colour, and of an immenfe fize, being no lefs than 365 feet. He adds, that it was found in a certain village or town, near the mountain called in his days *Jibal Soliman*, or "the mountain of Solomon."

165 They make a defcent on Spain.

166 And over-run the whole country.

After Mufa and Tarik had committed dreadful depredations in Spain, they were both recalled by the khalif; but the next year, Tarik having undertaken another expedition into the fame country, landed a body of 12,000 men at Gibraltar, with which he plundered the whole province of Bætica, and over-ran the greateft part of Lufitania. Roderic hearing of thefe depredations, fent againft him an army of raw undifciplined troops, who were eafily defeated, and moft of them left dead on the fpot; which fo animated the Arab commander, that he refolved not to lay down his arms till he had made an abfolute conqueft of Spain. About the fame time that Tarif made fuch progrefs in Spain, another Moflem general entered Pifidia with a powerful army, took the city of Antioch, and, after having ravaged the country, retired into the khalif's territories with very little lofs.

In

167 Al Hejaj dies.

In the 95th year of the Hegira died Al Hejaj governor of Irak, &c. after he had preſided over that country 20 years. He exerciſed ſuch cruelties upon thoſe who were in ſubjection to him, that he is ſaid to have killed 120,000 men, and to have ſuffered 50,000 men and 30,000 women to periſh in priſon. To excuſe this cruelty, he uſed frequently to ſay, That a ſevere, or even violent government, is better than one too weak and indulgent; as the firſt only hurts particular perſons, but the latter the whole community. This year alſo the Arabs gained a complete victory in Spain over Roderic king of the Goths, who periſhed in the action. In this campaign, Tarif poſſeſſed himſelf of immenſe treaſures; by which means he was enabled to reward not only his officers, but common ſoldiers alſo. In the eaſtern parts of the world alſo, the Arabs were this year very formidable; Moſlema, an Arab general, having entered the imperial territories, ravaged the whole province of Galatia, carrying off with him many rich ſpoils, and a vaſt number of priſoners. The Greek emperor, hearing that Al-Walid deſigned to attack him both by ſea and land, ſent ſome of his nobles to treat of a peace; and, among other things, deſired them to bring him a particular account of the force with which the khalif deſigned to invade the Greek empire. This they repreſented as ſo terrible, that it would be next to impoſſible to oppoſe it. The emperor therefore cauſed a great number of light ſhips to be built, the walls to be repaired, and ordered ſuch of the citizens as had not laid up proviſions for three years to depart the city. Al Walid, in the mean time, continued his warlike preparations with the utmoſt vigour, being determined to make himſelf maſter of Conſtantinople in a ſingle campaign.

168 Al Walid dies, and is ſucceeded by Soliman.

In the 96th year of the Hegira died the khalif Al Walid, and was ſucceeded by his brother Soliman. This year the Moſlem conqueſts on the eaſt ſide were increaſed by the reduction of Tabreſtan and Jurgan or Georgiana. In Spain, alſo, the city of Toledo which had revolted was reduced, and Cæſar-Auguſta, now Saragoſſa, as well as ſeveral others. The next year

169 Conſtantinople unſucceſsfully beſieged.

Moſlema ſet out for Conſtantinople, which he beſieged without ſucceſs till the 99th year of the Hegira; at which time he was obliged to return, after having loſt before it 120,000 men. The ſoldiers were reduced to the greateſt extremities of hunger, being forced to live upon hides, the roots and bark of trees, the moſt noiſome animals, and even the dead bodies of their com-

170 Death of Soliman.

panions. This year alſo (the 99th of the Hegira) is remarkable for the death of the khalif Soliman. According to ſome, he was poiſoned by Yezid his brother, governor of Perſia, who was diſpleaſed with his having appointed his couſin-german, Omar Ebn Abdalaziz as his ſucceſſor, to the excluſion of himſelf. According to others, he died of an indigeſtion; which is not greatly to be wondered at, if, as thoſe authors ſay, he uſed to devour 100 pounds weight of meat every day, and dine very heartily after eating three lambs roaſted for breakfaſt. In the latter part of his reign, the Moſlems were by no means ſucceſsful in Spain; the kingdom of Navarre being founded at this time by Pelagius, or Pelayo, whom the Arabs were never able to reduce.

The new khalif Omar Ebn Abdalaziz was by no means of a martial character; but is ſaid to have been very pious, and poſſeſſed of very amiable qualities. He ſuppreſſed the uſual malediction, which was ſolemnly pronounced by the khalifs of the houſe of Ommiyah againſt the houſe of Ali; and always ſhowed great kind-

171 New khalif poiſoned.

neſs to the latter. He was poiſoned by Yezid, after a ſhort reign of two years and five months. It is related, as an inſtance of this khalif's humility, that when Moſlema viſited him in his laſt ſickneſs occaſioned by the poiſon, he lay upon a bed of palm-tree leaves, ſupported by a pillow formed of beaſts ſkins, and covered with an ordinary garment. He had alſo on a dirty ſhirt; for which Moſlema blamed his ſiſter Fatima, Omar's wife; but ſhe excuſed herſelf by telling him, that the emperor of the faithful had not another ſhirt to put on.

Concerning Yezid the ſucceſſor of Omar, we find very little worth mentioning. He did not long enjoy the dignity he had ſo iniquitouſly purchaſed, dying after a reign of little more than four years. He died of grief for a favourite concubine named *Hababah*, who was accidentally choked by a large grape which ſtuck in her throat.

Yezid was ſucceeded by his brother Heſham, who aſcended the throne in the 105th year of the Hegira. In the ſecond and third year of his reign, ſeveral incurſions were made into the imperial territories, but generally without ſucceſs. In the 109th year of the He-

172 The Turks defeated.

gira, Moſlema drove the Turks out of Armenia and Aderbijan, and again confined them within the Caſpian gates. The next year he obliged them to take an oath that they would keep their own country; but this they ſoon violated, and were again driven back by Moſlema.

173 France invaded by the Arabs.

About this time alſo the Arabs, having paſſed the Pyrenees, invaded France to the number of 400,000, including women and ſlaves, under the command of one Abdalrahman. Having advanced to Arles upon the Rhone, they defeated a large body of French that oppoſed them; and having alſo defeated Count Eudo, they purſued him through ſeveral provinces, waſted the whole country with fire and ſword, making themſelves maſters of the city of Tours, moſt of which they redu-

174 They are utterly defeated by Charles Martel.

ced to aſhes. Here, however, a ſtop was put to their devaſtations by Charles Martel; who, coming up with them near the above-mentioned city, engaged them for ſeven days together, and at laſt gave them a total overthrow. The French general made himſelf maſter of all their baggage and riches; and Abdalrahman, with the ſhattered remains of his army, reached the frontiers of Spain with the utmoſt difficulty. The following year alſo, according to ſome hiſtorians, the Arabs were overthrown at Illiberis, ſcarce any of them making their eſcape. To make amends for this bad fortune, however, the khalif's arms were ſucceſsful againſt the Turks, who had again invaded ſome of the eaſtern provinces.

In the 125th year of the Hegira died the khalif Heſham, after a reign of 19 years ſeven months and eleven days. He was ſucceeded by Al Walid II. who is repreſented as a man of a moſt diſſolute life, and was aſſaſſinated the following year, on account of his profeſſing *Zendiciſm*, a ſpecies of infidelity nearly reſembling Sadduciſm. He was ſucceeded by Yezid the ſon of Al Walid I. who died of the plague after a reign of ſix months; and was ſucceeded by Ibrahim Ebn Al Walid, an imprudent and ſtupid prince. He was deposed in the 127th year of the Hegira by Merwan Ebn Mahomet, the governor of Mesopotamia;

175 Reign of Merwan.

who gave out as an excuse for his revolt, that he intended to revenge the murder of the khalif Al Walid II. He was no sooner seated on the throne, than the people of Hems rebelled against him. Against them the khalif marched with a powerful army; and asking them what could excite them to this rebellion, summoned them to surrender. They assured him that they were disposed to admit him into their city; and, accordingly, one of the gates being opened, Merwan entered with about 300 of his troops. The men that entered with him were immediately put to the sword; and the khalif himself escaped with great difficulty. However, he afterwards defeated them in a pitched battle, put a great number of them to the sword, dismantled the city, and crucified 600 of the principal authors of the revolt.

This, however, was far from quieting the commotions in different parts of the empire. The inhabitants of Damascus soon followed the example of those of Hems, and deposed the khalif's governor; but Merwan, immediately after the extinction of the former rebellion, marched to Damascus with great celerity, entered the city by force, and brought to condign punishment the authors of the revolt. Peace, however, was no sooner established at Damascus, than Soliman Ebn Hesham set up for himself at Basra, where he was proclaimed khalif by the inhabitants. Here he assembled an army of 10,000 men, with whom he marched to Kinnissin, where he was joined by vast numbers of Syrians who flocked to him from all parts. Merwan, receiving advice of Soliman's rapid progress, marched against him with all the forces he could assemble, and entirely defeated him. In this engagement Soliman lost 30,000 men, so that he was obliged to fly to Hems, where 900 men took an oath to stand by him to the last. Having ventured, however, to attack the khalif's forces a second time, he was defeated, and again forced to fly to Hems. But being closely pursued by Merwan, he constituted his brother Saad governor of the city, leaving with him the shattered remains of his troops, and himself fled to Tadmor. Soon after his departure Merwan appeared before the town, which he besieged for seven months; during which time he battered it incessantly with 80 catapults. The citizens being reduced to the last extremity, surrendered, and delivered Saad into the khalif's hands. In consideration of this submission, Merwan pardoned the rebels, and took them all under his protection. About the same time, another pretender to the khalifat appeared at Cufa; but Merwan took his measures so well, that he extinguished this rebellion before it could come to any height.

176 A party formed against him in Khorasan.

Notwithstanding the success, however, that had hitherto attended Merwan, a strong party was formed against him in Khorasan by the house of Al Abbas. The first of that house that made any considerable figure was named *Mahomet*, who flourished in the reign of Omar Ebn Abdalaziz. He was appointed chief of the house of Al Abbas, about the 100th year of the Hegira; and is said to have prophesied, that after his death, one of his sons named *Ibrahim* should preside over them till he was killed, and that his other son Abdallah surnamed *Abul Abbas Al Saffah*, should be khalif, and exterminate the house of Ommiyah. Upon this Al Saffah was introduced as the future sovereign, and those present kissed his hands and feet.

After the decease of Mahomet, his son Ibrahim nominated as his representative in Khorasan one Abu Moslem, a youth of 19 years of age; who beginning to raise forces in that province, Merwan dispatched against him a body of horse under the command of Nasr Ebn Sayer: but that general was entirely defeated by Abu Moslem, and the greatest part of his men killed.

177 Merwan's forces defeated.

The next year (the 128th of the Hegira) Merwan made vast preparations to oppose Abu Moslem, who after the late victory began to grow formidable to several parts of the empire. According to some authors, Merwan gained two victories over some of Ibrahim's generals: but the year following, Abu Moslem brought such a formidable army into the field, that the khalif's troops could not make head against them; his officers in Khorasan therefore were obliged either to take an oath of allegiance to Ibrahim, or to quit the province within a limited time.

In the 130th year of the Hegira, the khalif's general Nasr having drawn together another army, was again defeated by Kahtaba another of Ibrahim's generals, and forced to fly to Raya, a town of Dylam, according to some, or of Khorasan, according to others.

178 Ibrahim put to death.

The next year Ibrahim, having foolishly taken it into his head to go on a pilgrimage to Mecca, attended by a numerous retinue splendidly accoutred, was seized and put to death by Merwan; and the year following Abul Abbas was proclaimed khalif at Cufa. As soon as the ceremony was ended, he sent his uncle Abdallah with a powerful army to attack Merwan's forces that were encamped near Tubar, at a small distance from Mosul, where that khalif was then waiting for an account of the success of his troops under Yezid governor of Irak against Khatahba, one of Al Saffah's generals. Khatahba receiving advice of Yezid's approach, immediately advanced against him, and entirely defeated him; but in crossing the Euphrates, the waters of which were greatly swelled, he was carried away by the current and drowned. The pursuit, however, was continued by his son Hamid, who dispersed the fugitives in such a manner that they could never afterwards be rallied.

179 Merwan himself defeated,

At the news of this disaster, Merwan was at first greatly dispirited; but soon recovering himself, he advanced to meet Abdallah. In the beginning of the battle, the khalif happened to dismount; and his troops perceiving their sovereign's horse without his rider, concluded that he was killed, and therefore immediately fled; nor was it in the power of the khalif himself to rally them again, so that he was forced to fly to Damascus: but the inhabitants of that city, seeing his condition desperate, shut their gates against him,

180 And killed.

Upon this he fled to Egypt, where he maintained himself for some time; but was at last attacked and killed by Saleh, Abdallah's brother, in a town of Thebair, called *Busir Kurides*. The citizens of Damascus, tho' they had shamefully deserted Merwan, refused to open their gates to the victors; upon which Saleh entered the city by force, and gave it up to be plundered for three days by his soldiers.

By the total defeat and death of Merwan, Al Saffah remained sole master of the Moslem throne; but we hear of no very remarkable events that happened during

his

Arabia. his reign: only that he massacred great numbers of the partizans of the house of Ommiyah; and that Constantine Copronymus, taking advantage of the intestine divisions among the Moslems, ravaged Syria. The khalif died of the small-pox in the 136th year of the Hegira, in the 33d year of his age; and was succeeded by his brother Al Mansur. In the beginning of Al

181 Reign of Al Mansur. Mansur's reign, hostilities continued against the house of Ommiyah, who still made resistance, but were always defeated. Abdallah, however, the khalif's uncle, caused himself to be proclaimed khalif at Damascus; and having assembled a powerful army in Arabia, Syria, and Mesopotamia, advanced with great expedition to the banks of the Masius near Nisibus, where he encamped. Al Mansur, being informed of this rebellion, dispatched Abu Moslem against Abdallah. This general, having harassed him for five months together, at last brought him to a general action; and having entirely defeated him, forced him to fly to Basra. Not-

182 He murders Abu Moslem. withstanding all his services, however, Abu Moslem was soon after ungratefully and barbarously murdered by Al Mansur, on some ridiculous pretences of being deficient in respect towards him.

After the death of Abu Moslem, one Sinan a Magian, or adorer of fire, having made himself master of that general's treasures, revolted against the khalif; but he was soon defeated by Jamhur Ebn Morad, who had been sent against him with a powerful army. In this expedition Jamhur having acquired immense riches, the covetous disposition of the khalif prompted him to send a person express to the army to seize upon all the wealth. This so provoked Jamhur, that he immediately turned his arms against his master; but was soon defeated, and entirely reduced. The following year (the

183 Abdalrahman proclaimed khalif in Spain. 139th of the Hegira), one Abdalrahman, of the house of Ommiyah, after the entire ruin of that family in Asia, arrived in Spain, where he was acknowledged khalif; nor did he or his descendants ever afterwards own subjection to the Arabian khalifs.

184 Attempt to assassinate the khalif. The 140th year of the Hegira is remarkable for an attempt to assassinate the khalif. This attempt was made by the Rawandians; an impious sect, who held the doctrine of metempsychosis or transmigration.—They first offered Al Mansur divine honours, by going in procession round his palace, as the Moslems were wont to do round the Caab; but the khalif, highly incensed at this impiety, ordered 100 of the principal of them to be imprisoned. These however were soon released by their companions; who then went in a body to the palace with an intention to murder their sovereign: but he being a person of uncommon bravery, though he was surprised with very few attendants, mounted a mule, and advanced towards the mutineers with an intention to sell his life as dear as possible. In the mean time, Maan Ebn Zaidat, one of the chiefs of the Ommiyan faction, who had concealed himself in order to avoid the khalif's resentment, sallied out of his retreat, and putting himself at the head of Al Mansur's attendants, charged the rebels with such fury, that he entirely defeated them. This generosity of Maan was so remarkable, that it afterwards passed into a proverb. On this occasion 6000 of the Rawandians were killed on the spot, and the khalif delivered from instant death: he was, however, so much disgusted with the Arabs on account of this attempt, that he resolved to remove the capital of his empire out of their peninsula; and accordingly founded a new city on the banks of the Tigris, which from that time to this has been known by the name of *Bagdad*. The foundations of it were laid in the 145th year of the Hegira, and finished four years after. Arabia. 185 He removes the seat of empire to Bagdad.

On the removal of the seat of government to Bagdad, the peninsula of the Arabs seems all at once to have lost its consequence, and in a short time the inhabitants seem even to have detached themselves from the jurisdiction of the khalifs: for in the 156th year of the Hegira, while Al Mansur was yet living, they made irruptions into Syria and Mesopotamia, as if they had designed to conquer these countries over again for themselves; and though the Arabs, properly so called, continued nominally subject to the khalifs of Bagdad till the abolition of the khalifat by Hulaku the Tartar, yet they did not become subject to him when he became master of that city. There is even the strongest reason to believe that the Arabs (i. e. the inhabitants of the peninsula properly called *Arabia*) have remained independent, not only of Hulaku, but of every other conqueror that the world hath yet produced.

The perpetual independence of the Arabs, indeed, "has been the theme of praise among strangers and natives. The kingdom of Yemen it is true, has been successively subdued by the Abyssinians, the Persians, the sultans of Egypt, and the Turks; the holy cities of Mecca and Medina have repeatedly bowed under a Scythian tyrant; and the Roman province of Arabia embraced the peculiar wilderness in which Ismael and his sons must have pitched their tents in the face of their brethren. Yet these exceptions are temporary or local; the body of the nation has escaped the yoke of the most powerful monarchies: the arms of Sesostris and Cyrus, of Pompey and Trajan, could never achieve the conquest of Arabia; the present sovereign of the Turks may exercise a shadow of jurisdiction, but his pride is reduced to solicit the friendship of a people whom it is dangerous to provoke and fruitless to attack. The obvious causes of their freedom are inscribed on the character and country of the Arabs. Many ages before Mahomet, their intrepid valour had been severely felt by their neighbours in offensive and defensive war. The patient and active virtues of a soldier are insensibly nursed in the habits and discipline of a pastoral life. The care of the sheep and camels is abandoned to the women of the tribe; but the martial youth, under the banner of the emir, is ever on horseback, and in the field, to practice the exercise of the bow, the javelin, and the scymetar. The long memory of their independence is the firmest pledge of its perpetuity; and succeeding generations are animated to prove their descent and to maintain their inheritance. Their domestic feuds are suspended on the approach of a common enemy; and in their last hostilities against the Turks, the caravan of Mecca was attacked and pillaged by fourscore thousand of the confederates. When they advance to battle, the hope of victory is in the front; and in the rear, the assurance of a retreat. Their horses and camels, who in eight or ten days can perform a march of four or five hundred miles, disappear before the conqueror; the secret waters of the desart elude his search; and his victorious troops are consumed with thirst, hunger and fatigue, in

Gibbon's *Hist.* vol. v. p. 178.

186 National independence of the Arabs.

Arabia. in the purſuit of an invſible foe, who ſcorns his efforts, and ſafely repoſes in the heart of the burning ſolitude. The arms and deſarts of the Bedoweens are not only the ſafeguards of their own freedom, but the barriers alſo of the Happy Arabia, whoſe inhabitants, remote from war, are enervated by the luxury of the ſoil and climate. The legions of Auguſtus melted away in diſeaſe and laſſitude; and it is only by a naval power that the reduction of Yemen has been ſucceſsfully attempted. When Mahomet erected his holy ſtandard, that kingdom was a province of the Perſian empire; yet ſeven princes of the Homerites ſtill reigned in the mountains; and the vicegerent of Choſroes was tempted to forget his diſtant country and his unfortunate maſter. The hiſtorians of the age of Juſtinian repreſent the ſtate of the independent Arabs, who were divided by intereſt or affection in the long quarrel of the Eaſt: the tribe of Gaſſan was allowed to encamp on the Syrian territory: the princes of Hira were permitted to form a city about forty miles to the ſouthward of the ruins of Babylon. Their ſervice in the field was ſpeedy and vigorous; but their friendſhip was venal, their faith inconſtant, their enmity capricious: it was an eaſier taſk to excite than to diſarm theſe roving barbarians; and, in the familiar intercourſe of war, they learned to ſee, and to deſpiſe, the ſplendid weakneſs both of Rome and Perſia. From Mecca to the Euphrates, the Arabian tribes were confounded by the Greeks and Latins, under the general appellation of Saracens; a name which every Chriſtian mouth has been taught to pronounce with terror and abhorrence.

187 Their domeſtic freedom and character.

"The ſlaves of domeſtic tyranny may vainly exult in their national independence; but the Arab is perſonally free; and he enjoys, in ſome degree, the benefits of ſociety, without forfeiting the prerogatives of nature. In every tribe ſuperſtition, or gratitude, or fortune, has exalted a particular family above the heads of their equals. The dignities of ſheich and emir invariably deſcend in this choſen race; but the order of ſucceſſion is looſe and precarious; and the moſt worthy or aged of the noble kinſmen are preferred to the ſimple, though important, office of compoſing diſputes by their advice, and guiding valour by their example. The momentary junction of ſeveral tribes produces an army: their more laſting union conſtitutes a nation; and the ſupreme chief, the emir of emirs, whoſe banner is diſplayed at their head, may deſerve, in the eyes of ſtrangers, the honours of the kingly name. If the Arabian princes abuſe their power, they are quickly puniſhed by the deſertion of their ſubjects, who had been accuſtomed to a mild and parental juriſdiction. Their ſpirit is free, their ſteps are unconfined, the deſart is open, and the tribes and families are held together by a mutual and voluntary compact. The ſofter natives of Yemen ſupported the pomp and majeſty of a monarch; but if he could not leave his palace without endangering his life, the active powers of government muſt have been devolved on his nobles and magiſtrates. The cities of Mecca and Medina preſent, in the heart of Aſia, the form or rather the ſubſtance of a commonwealth. The grandfather of Mahomet, and his lineal anceſtors, appear in foreign and domeſtic tranſactions as the princes of their country; but they reigned like Pericles at Athens, or the Medici at Florence, by the opinion of their wiſdom and integrity; their influence was divided with their patrimony; and the ſceptre was transferred from the uncles of the prophet to a younger branch of the tribe of Koreiſh. On ſolemn occaſions they convened the aſſembly of the people; and, ſince mankind muſt be either compelled or perſuaded to obey, the uſe and reputation of oratory among the ancient Arabs is the cleareſt evidence of public freedom. But their ſimple freedom was of a very different caſt from the nice and artificial machinery of the Greek and Roman republics, in which each member poſſeſſed an undivided ſhare of the civil and political rights of the community. In the more ſimple ſtate of the Arabs, the nation is free, becauſe each of her ſons diſdains a baſe ſubmiſſion to the will of a maſter. His breaſt is fortified with the auſtere virtues of courage, patience, and ſobriety: the love of independence prompts him to exerciſe the habits of ſelf-command; and the fear of diſhonour guards him from the meaner apprehenſion of pain, of danger, and of death. The gravity and firmneſs of the mind is conſpicuous in its outward demeanor: his ſpeech is ſlow, weighty, and conciſe; he is ſeldom provoked to laughter; his only geſture is that of ſtroaking his beard, the venerable ſymbol of manhood; and the ſenſe of his own importance teaches him to accoſt his equals without levity, and his ſuperiors without awe. The liberty of the Saracens ſurvived their conqueſts: the firſt khalifs indulged the bold and familiar language of their ſubjects: they aſcended the pulpit to perſuade and edify the congregation; nor was it before the ſeat of empire was removed to the Tigris, that the Abbaſſides adopted the proud and pompous ceremonial of the Perſian and Byzantine courts.

188 Civil wars and private revenge.

"In the ſtudy of nations and men, we may obſerve the cauſes that render them hoſtile or friendly to each other, that tend to narrow or enlarge, to mollify or exaſperate, the ſocial character. The ſeparation of the Arabs from the reſt of mankind has accuſtomed them to confound the ideas of ſtranger and enemy; and the poverty of the land has introduced a maxim of juriſprudence, which they believe and practiſe to the preſent hour. They pretend, that in the diviſion of the earth the rich and fertile climates were aſſigned to the other branches of the human family; and that the poſterity of the outlaw Iſmael might recover, by fraud or force, the portion of inheritance of which he had been unjuſtly deprived. According to the remark of Pliny, the Arabian tribes are equally addicted to theft and merchandiſe: the caravans that traverſe the deſart are ranſomed or pillaged; and their neighbours, ſince the remote times of Job and Seſoſtris, have been the victims of their rapacious ſpirit. If a Bedoween diſcovers from afar a ſolitary traveller, he rides furiouſly againſt him, crying, with a loud voice, "Undreſs thyſelf, thy aunt (*my wife*) is without a garment." A ready ſubmiſſion intitles him to mercy; reſiſtance will provoke the aggreſſor, and his own blood muſt expiate the blood which he preſumes to ſhed in legitimate defence. A ſingle robber, or a few aſſociates, are branded with their genuine name; but the exploits of a numerous band aſſume the character of lawful and honourable war. The temper of a people, thus armed againſt mankind, was doubly inflamed by the domeſtic licence of rapine, murder, and revenge. In the conſtitution of Europe, the right of peace and war is now

now confined to a ſmall, and the actual exerciſe to a much ſmaller, liſt of reſpectable potentates; but each Arab, with impunity and renown, might point his javelin againſt the life of his countryman. The union of the nation conſiſted only in a vague reſemblance of language and manners; and in each community the juriſdiction of the magiſtrate was mute and impotent. Of the time of ignorance which preceded Mahomet, 1700 battles are recorded by tradition: hoſtility was embittered with the rancour of civil faction; and the recital, in proſe or verſe, of an obſolete feud was ſufficient to rekindle the ſame paſſions among the deſcendants of the hoſtile tribes. In private life, every man, at leaſt every family, was the judge and avenger of its own cauſe. The nice ſenſibility of honour, which weighs the inſult rather than the injury, ſheds its deadly venom on the quarrels of the Arabs: the honour of their women, and of their *beards*, is moſt eaſily wounded; an indecent action, a contemptuous word, can be expiated only by the blood of the offender; and ſuch is their patient inveteracy, that they expect whole months and years the opportunity of revenge. A fine or compenſation for murder is familiar to the barbarians of every age: but in Arabia the kinſmen of the dead are at liberty to accept the atonement, or, to exerciſe with their own hands the law of retaliation. The refined malice of the Arabs refuſes even the head of the murderer, ſubſtitutes an innocent to the guilty perſon, and transfers the penalty to the beſt and moſt conſiderable of the race by whom they have been injured. If he falls by their hands, they are expoſed in their turn to the danger of repriſals; the intereſt and principal of the bloody debt are accumulated; the individuals of either family lead a life of malice and ſuſpicion, and 50 years may ſometimes elapſe before the account of vengeance be finally ſettled. This ſanguinary ſpirit, ignorant of pity or forgiveneſs, has been moderated, however, by the maxims of honour, which require in every private encounter ſome decent equality of age and ſtrength, of numbers and weapons.

189
Annual truce.

An annual feſtival of two, perhaps of four months, was obſerved by the Arabs before the time of Mahomet; during which their ſwords were religiouſly ſheathed both in foreign and domeſtic hoſtility: and this partial truce is more ſtrongly expreſſive of the habits of anarchy and warfare.

190
Their ſocial qualifications and virtues.

"But the ſpirit of rapine and revenge was attempered by the milder influence of trade and literature. The ſolitary peninſula is encompaſſed by the moſt civilized nations of the ancient world: the merchant is the friend of mankind; and the annual caravans imported the firſt ſeeds of knowledge and politeneſs into the cities, and even the camps of the deſart. The arts of grammar, of metre, and of rhetoric, were unknown to the freeborn eloquence of the Arabian; but their penetration was ſharp, their fancy luxuriant, their wit ſtrong and ſententious, and their more elaborate compoſitions were

191
Love of poetry.

addreſſed with energy and effect to the minds of their hearers. The genius and merit of a riſing poet was celebrated by the applauſe of his own and the kindred tribes. A ſolemn banquet was prepared, and a chorus of women, ſtriking their tymbals, and diſplaying the pomp of their nuptials, ſung in the preſence of their ſons and huſbands the felicity of their native tribe; that a champion had now appeared to vindicate their rights; that a herald had raiſed his voice to immortaliſe their renown. The diſtant or hoſtile tribes reſorted to an annual fair, which was aboliſhed by the fanaticiſm of the firſt Moſlems; a national aſſembly that muſt have contributed to refine and harmoniſe the barbarians. Thirty days were employed in the exchange, not only of corn and wine, but of eloquence and poetry. The prize was diſputed by the generous emulation of the bards; the victorious performance was depoſited in the archives of princes and emirs; and we may read in our own language the ſeven original poems which were inſcribed in letters of gold and ſuſpended in the temple of Mecca. The Arabian poets were the hiſtorians and moraliſts of the age; and if they ſympathiſed with the prejudices, they inſpired and crowned the virtues, of their countrymen. The indiſſoluble union of generoſity and valour was the darling theme of their ſong; and when they pointed their keeneſt ſatyr againſt a deſpicable race, they affirmed, in the bitterneſs of reproach, that the men knew not how to give, nor the women to deny. The ſame hoſpitality which was practiſed by Abraham, and celebrated by Homer, is ſtill renewed in the camps of the Arabs. The ferocious Bedoweens, the terror of the deſart, embrace, without enquiry or heſitation, the ſtranger who dares to confide in their honour and to enter their tent. His treatment is kind and reſpectful: he ſhares the wealth or the poverty of his hoſt; and after a needful repoſe, he is diſmiſſed on his way, with thanks, with bleſſings, and perhaps with gifts.

192
Ancient idolatry.

"The religion of the Arabs, as well as of the Indians, conſiſted in the worſhip of the ſun, the moon, and the fixed ſtars; a primitive and ſpecious mode of ſuperſtition. The bright luminaries of the ſky diſplay the viſible image of a deity; their number and diſtance convey to a philoſophic, or even a vulgar eye, the idea of boundleſs ſpace: the character of eternity is marked on theſe ſolid globes, that ſeem incapable of corruption or decay: the regularity of their motions may be aſcribed to a principle of reaſon or inſtinct; and their real or imaginary influence encourages the vain belief that the earth and its inhabitants are the object of their peculiar care. The ſcience of aſtronomy was cultivated at Babylon; but the ſchool of the Arabs was a clear firmament and a naked plain. In their nocturnal marches, they ſteered by the guidance of the ſtars: their names, and order, and daily ſtation, were familiar to the curioſity and devotion of the Bedoween; and he was taught by experience to divide in 28 parts the zodiac of the moon, and to bleſs the conſtellations, who refreſhed, with ſalutary rains, the thirſt of the deſart. The reign of the heavenly orbs could not be extended beyond the viſible ſphere; and ſome metaphyſical powers were neceſſary to ſuſtain the tranſmigration of ſouls and the reſurrection of bodies: a camel was left to periſh on the grave, that he might ſerve his maſter in another life; and the invocation of departed ſouls implies that they were ſtill endowed with conſciouſneſs and power. Each tribe, each family, each independent warrior, created and changed the rites and the object of his fantaſtic worſhip; but the nation, in every age, has bowed to the religion, as

Arabia.

193 The Caaba or temple of Mecca. well as to the language of Mecca. The genuine antiquity of the Caaba extends beyond the Christian æra: in describing the coast of the Red Sea, the Greek historian Diodorus has remarked, between the Thamaudites and the Sabæans, a famous temple, whose superior sanctity was revered by *all* the Arabians: the linen or silken veil, which is annually renewed by the Turkish emperor, was first offered by a pious king of the Homerites, who reigned 700 years before the time of Mahomet. A tent or a cavern might suffice for the worship of the savages, but an edifice of stone and clay has been erected in its place; and the art and power of the monarchs of the East have been confined to the simplicity of the original model. A spacious portico incloses the quadrangle of the Caaba; a square chapel, 24 cubits long, 23 broad, and 27 high: a door and a window admit the light; the double roof is supported by three pillars of wood; a spout (now of gold) discharges the rain-water, and the well Zemzem is protected by a dome from accidental pollution. The tribe of Koreish, by fraud or force, had acquired the custody of the Caaba: the sacerdotal office devolved through four lineal descents to the grandfather of Mahomet; and the family of the Hashemites, from whence he sprung, was the most respectable and sacred in the eyes of their country. The precincts of Mecca enjoyed the rights of sanctuary; and, in the last month of each year, the city and the temple were crowded with a long train of pilgrims, who presented their vows and offerings in the house of God. The same rites which are now accomplished by the faithful Mussulman were invented and practised by the superstition of the idolaters. At an awful distance they cast away their garments: seven times, with hasty steps, they encircled the Caaba, and kissed the black stone: seven times they visited and adored the adjacent mountains; seven times they threw stones into the valley of Mina; and the pilgrimage was atchieved, as at the present hour, by a sacrifice of sheep and camels, and the burial of their hair and nails in the consecrated ground. Each tribe either found or introduced in the Caaba their domestic worship: the temple was adorned, or defiled, with 360 idols of men, eagles, lions, and antelopes; and most conspicuous was the statue of Hebal, of red agate, holding in his hand seven arrows, without heads or feathers, the instruments and symbols of profane divination. But this statue was a monument of Syrian arts: the devotion of the ruder ages was content with a pillar or a tablet; and the rocks of the desart were hewn into gods or altars, in imitation of the black stone of Mecca, which is deeply tainted with the reproach of an idolatrous origin. From Japan to Peru,

194 Sacrifices and rites. the use of sacrifice has universally prevailed; and the votary has expressed his gratitude or fear by destroying or consuming, in honour of the gods, the dearest and most precious of their gifts. The life of a man is the most precious oblation to deprecate a public calamity: the altars of Phœnicia and Egypt, of Rome and Carthage, have been polluted with human gore: the cruel practice was long preserved among the Arabs; in the third century, a boy was annually sacrificed by the tribe of the Dumatians; and a royal captive was piously slaughtered by the prince of the Saracens, the ally and soldier of the emperor Justinian. The father of Mahomet himself was devoted by a rash vow, and hardly ransomed for the equivalent of 100 camels. The Arabs, like the Jews and Egyptians, abstained from the taste of swine's flesh; and they circumcised their children at the age of puberty: the same customs, without the censure or the precept of the Koran, have been silently transmitted to their posterity and proselytes; and it has been sagaciously conjectured, that the artful legislator indulged the stubborn prejudices of his countrymen.

195 Introduction of the Sabians. "Arabia was free: From the adjacent kingdoms, which were shaken by the storms of conquest and tyranny, the persecuted sects fled to the happy land where they might profess what they thought, and practise what they professed; and the religions of the Sabians and Magians, of the Jews and Christians, were disseminated from the Persian Gulf to the Red Sea. In a remote period of antiquity, Sabianism was diffused over Asia by the science of the Chaldæans and the arms of the Assyrians. From the observations of 2000 years, the priests and astronomers of Babylon deduced the eternal laws of nature and providence. They adored the seven gods or angels who directed the course of the seven planets, and shed their irresistible influence on the earth. The attributes of the seven planets, with the twelve signs of the zodiac, and the twenty-four constellations of the northern and southern hemisphere, were represented by images and talismans; the seven days of the week were dedicated to their respective deities; the Sabians prayed thrice each day; and the temple of the moon at Haran was the term of their pilgrimage. But the flexible genius of their faith was always ready either to teach or to learn. The altars of Babylon were overturned by the Magians; but 196 The Magians.

the injuries of the Sabians were revenged by the sword of Alexander; Persia groaned above 500 years under a foreign yoke; and the purest disciples of Zoroaster escaped from the contagion of idolatry, and breathed with their adversaries the freedom of the desart. Seven hundred years before the death of Mahomet the 197 The Jews.

Jews were settled in Arabia: and a far greater multitude was expelled from the holy land in the wars of Titus and Hadrian. The industrious exiles aspired to liberty and power: they erected synagogues in the cities and castles in the wilderness; and their Gentile converts were confounded with the children of Israel, whom they resembled in the outward mark of circumcision. The Christian missionaries were still more ac- 197 The Christians.

tive and successful: the Catholics asserted their universal reign; the sects whom they oppressed successively retired beyond the limits of the Roman empire; the Marcionites and Manichæans dispersed their *fantastic* opinions and apocryphal gospels; the churches of Yemen, and the princes of Hira and Gassen, were instructed in a purer creed by the Jacobite and Nestorian bishops." Such was the state of religion in Arabia previous to the appearance of Mahomet. See n° 22. *supra*.

As the Arabs are one of the most ancient nations in the world, having inhabited the country they at present possess almost from the deluge, without intermixing with other nations, or being subjugated by any foreign power, their language must have been formed soon after, if not at, the confusion of Babel. The two principal

pal dialects of it were, that ſpoken by the Hamyarites and other genuine Arabs, and that of the Koreiſh, in which Mahomet wrote the Koran. The firſt is ſtyled by the Oriental writers the *Arabic* of *Hamyar*, and the other *the pure* or *defecated*. As Yarab, grandfather of Hamyar, is ſuppoſed by the Oriental writers to have been the firſt whoſe tongue deviated from the Syriac to the Arabic, the Hamyaritic dialect, according them, muſt have approached nearer to the purity of the Syriac; and conſequently have been more remote from the true genius of the Arabic than that of any other tribe. The dialect of the Koreiſh, termed by the Koran *the perſpicuous and clear Arabic*, is referred to Iſhmael as its author; who, ſay the above-mentioned writers, firſt ſpoke it; and, as Dr Pocock believes, after he had contracted an alliance with the family of Jorham by marriage, formed it of their language and the original Hebrew. As, therefore, the Hamyaritic dialect partook principally of the Syriac, ſo that of the Koreiſh was ſuppoſed to conſiſt chiefly of the Hebrew. But, according to Jallalo'ddin, the politeneſs and elegance of the dialect of the Koreiſh ought rather to be attributed to their having, from the remoteſt antiquity, the cuſtody of the Caaba, and dwelling in Mecca the centre of Arabia. The Arabs are full of the commendations of their language, which is very harmonious, expreſſive, and, as they ſay, ſo immenſely copious, that no man uninſpired can be a perfect maſter of it in its utmoſt extent. How much, in this laſt article, it is ſuperior to the Greek and Latin tongues, in ſome meaſure appears from hence, that ſometimes a bare enumeration of the Arabic names of one particular thing, and an explication of them, will make a conſiderable volume. Notwithſtanding this, the Arabs believe the greateſt part of their language to be loſt; which will not ſeem improbable, when we conſider how late the art of writing became generally practiſed among them. For though it was known to Job their countryman, to the Edomites, as well as the other Arabian nations bordering upon Egypt and Phœnicia, and to the Hamyarites many centuries before Mahomet, as appears from ſome ancient monuments ſaid to be remaining in their character; yet the other Arabs, and thoſe of Mecca in particular, unleſs ſuch of them as were either Jews or Chriſtians, were to the time of Moramer perfectly ignorant of it. It was the ancient Arabic language preceding the reign of Juſtinian, which ſo nearly reſembled the Ethiopic; for ſince that time, and eſpecially ſince the age of Mahomet, all the Arabic dialects have been not a little corrupted. This is now the learned language of the Mahometans, who ſtudy it as the European Chriſtians do the Hebrew, Greek, and Latin.

199 Letters. The character uſed by them, the moſt ancient of any peculiar to the Arabs, wherein the letters were not diſtinctly ſeparate, went by the appellation of *Al Moſnad*, from the mutual dependency of its letters or parts upon one another. This was neither publickly taught, nor ſuffered to be uſed, without permiſſion firſt obtained. Could we depend upon what Al Firauzabadius relates from Ebn Haſhem, this character muſt have been of a very high antiquity; ſince an inſcription in it, according to the laſt author, was found in Yaman, as old as the time of Joſeph. Be that as it will, Moramer Ebn Morra of Anbar, a city of Irak, who lived not many years before Mahomet, was the inventor of the preſent Arabic character, which Baſhar the Kendian, who married the ſiſter of Abu Sofian, is ſaid to have learned from the houſe of Anbar, and to have introduced at Mecca but a little time before the inſtitution of Mahometiſm. Moramer's alphabet the Oriental authors agree to have been very different from the ancient one of the Hamyarites, ſince they diſtinguiſh the Hamyaritic and Arabic pens. In Mahomet's time, the Morameric alphabet had made ſo ſmall a progreſs, that no one in Yaman could either write or read it; nay, Mahomet himſelf was incapable of doing either; for which reaſon he was called the *illiterate prophet*. The letters of this alphabet were very rude; being either the ſame with, or very much like, the Cufic; which character is ſtill found in inſcriptions and the titles of ancient books; nay, for many years it was the only one uſed by the Arabs, the Koran itſelf being at firſt written therein. In order to perpetuate the memory of Moramer's invention, ſome authors call the Arabic letters *al Moramer*, i. e. *the progeny of Moramer*. The moſt remarkable ſpecimens of the *Cufic* character (ſo denominated from Cufa, a city of Irak, where ſome of the firſt copies of the Koran were written) are the following: Part of that book in it on vellum, brought from Egypt by Mr Greaves; ſome other fragments of the ſame book in it publiſhed by Sir John Chardin; certain paſſages of a MS. in the Bodleian library the legends on ſeveral Saracenic coins dug up not many years ago on the coaſt of the Baltic, not far from Dantzick; and, according to Mr Profeſſor Hunt, thoſe noble remains of it that are, or were lately, to be ſeen in Mr Joſeph Ames's valuable collection of antique curioſities. As to the true origin of the ancient and modern Arabic alphabets, we muſt own ourſelves pretty much in the dark. See ALPHABET.

The Arabian learning may be divided into two periods, viz. *Ante-Mahometan* and *Mahometan*. 200 Learning, &c.

The Arab learning, in this firſt period, conſiſted, according to Abulpharagius, in the knowledge of their language, the propriety of diſcourſe, the compoſition of verſe, and the ſcience of the ſtars: but their chief attention ſeems to have been directed to oratory and poetry.

The ſecond period is more diſtinguiſhed, at leaſt from the time of Al-Mamon, the ſeventh caliph of the family of the Abaſſides, who flouriſhed about the year 820, and has the honour of being the founder of the modern Arabian learning. He ſent for all the beſt books out of Chaldea, Greece, Egypt, and Perſia, relating to phyſic, aſtronomy, coſmography, muſic, chronology, &c. and penſioned a number of learned men, ſkilled in the ſeveral languages and ſciences, to tranſlate them into Arabic. By this means, divers of the Greek authors, loſt in their own country and language, have been preſerved in Arabic. From that time Arabia became the chief ſeat of learning; and we find mention by Abulpharagius, Pococke, D'Herbelot, and Hottinger, of learned men, and books without number.

The revival of learning in the 10th century, by Gerbert, known after his elevation to the pontificate by the title of Silveſter II. and afterwards among the Europeans in general, may be aſcribed to the inſtructions and writings of the Arabian doctors and philoſophers, and

and to the ſchools which they founded in ſeveral parts of Spain and Italy. And in the 12th century, the inquiſitive of different countries frequented the ſchools of the Saracens in Spain, and diſſeminated the knowledge which they obtained there after their return. At this time, many of the learned productions of the Arabians were tranſlated into Latin, which facilitated the general progreſs of ſcience.

The philoſophy of the Arabians, before Mahomet, was Sabian, and included the ſyſtem and ceremonies of that ſect of idolaters. This it was that Mahomet ſet himſelf to decry; and he is even ſaid by ſome to have carried his oppoſition ſo far, as to prohibit, if not puniſh, all ſtudy of philoſophy. But his followers, by degrees, got over this reſtraint; the love of learning increaſed; till, under the memorable caliphate of Al-Mamon, Ariſtotle's philoſophy was introduced and eſtabliſhed among them; and from them propagated, with their conqueſts, through Egypt, Africa, Spain, and other parts. As they choſe Ariſtotle for their maſter, they chiefly applied themſelves to that part of philoſophy called *logic*, and thus became proficients in the knowledge of words rather than things. Whence they have been ſometimes denominated, *Maſters of the wiſdom of words;* ſometimes the *Talking ſect.* Their philoſophy was involved in quaint arbitrary terms and notions, and their demonſtrations drawn from thence as from certain principles, &c. *Walch Hiſt. Log.* lib. ii. ſec. 2. § 1.

Their phyſic ſucceeded the Grecian; and their phyſicians handed down the art to us, having made conſiderable improvements, chiefly in the pharmaceutical and chemical parts.

It is certain we owe to them moſt of our ſpices and aromatics, as nutmegs, cloves, mace, and other matters of the produce of India. We may add, that moſt of the gentle purgatives were unknown to the Greeks, and firſt introduced by the Arabs, as manna, ſenna, rhubarb, tamarinds, caſſia, &c. They likewiſe brought ſugar into uſe in phyſic, where, before, only honey was uſed. They alſo found the art of preparing waters and oils, of divers ſimples, by diſtillation and ſublimation. The firſt notice of the ſmall-pox and the meaſles is likewiſe owing to them. Laſtly, the reſtoration of phyſic in Europe took its riſe from their writings. M. Le Clerc has given a ſketch, and Dr Freind an ample hiſtory of the Arabian phyſic. We have alſo a *notitia* of all the Arabian phyſicians by Fabricius.

Their poetry may be divided into two ages. The ancient, according to Voſſius, was no other than rhiming; was a ſtranger to all meaſure and rule; the verſes looſe and irregular, confined to no feet, number of ſyllables, or any thing elſe, ſo that they rhimed at the end; oftentimes all the verſes in the poem ended with the ſame rhime. It is in ſuch verſe that the alcoran is ſaid to be written.

The modern Arabian poetry takes its date from the caliphate of Al Raſchid, who lived toward the cloſe of the eight century. Under him poetry became an art, and laws of proſody were laid down. Their compariſons, in which they abound, are taken, with little choice, from tents, camels, hunting, and the ancient manners of the Arabs.

201 Mechanical arts.

That ſome of the Arabs had a good degree of knowledge in ſeveral mechanical arts, appears from Strabo, who informs us, that the people of Tamna and the adjacent provinces had magnificent temples, and elegant houſes, built in the Egyptian taſte. The ſame author likewiſe relates, that in Arabia Felix, beſides the huſbandmen, there were many artificers; and, among others, thoſe which made palm-wine, which he intimates, was much uſed by the Arabs. As for the exerciſe of arms and horſemanſhip, they looked upon this as one of their principal accompliſhments, being obliged to practiſe and encourage it by reaſon of the independency of their tribes, whoſe frequent jarring made wars almoſt continual amongſt them, which for the moſt part ended in field-battles. Hence it became an uſual ſaying amongſt them, that God had beſtowed four peculiar things on the Arabs, viz. *turbans inſtead of diadems, tents inſtead of walls and houſes, ſwords inſtead of intrenchments, and poems inſtead of written laws.* The principal arms uſed by the ancient Arabs were bows and arrows, darts or javelins, and broad ſwords or ſcymitars. The bows and arrows were the moſt ancient of theſe; being uſed by Iſhmael himſelf, according to Scripture. It is probable alſo, that ſome of them were acquainted with every branch of the military art cultivated by their neighbours the Egyptians, Syrians, and Phœnicians.

202 Commerce.

Before the Portugueſe interrupted the navigation of the Red ſea, the Arabs were the factors of all the trade that paſſed thro' that channel. Aden, which is ſituated at the moſt ſouthern extremity of Arabia upon the Indian ocean, was the mart in theſe parts. The ſituation of its harbour, which opened an eaſy communication with Egypt, Ethiopia, India, and Perſia, had rendered it, for many ages, one of the moſt flouriſhing factories in Aſia. Fifteen years after it had repulſed the great Albuquerque, who attempted to demoliſh it in 1513, it ſubmitted to the Turks, who did not long remain maſters of it. The king of Yemen, who poſſeſſed the only diſtrict in Arabia that merits the title of *Happy*, drove them from thence, and removed the trade to Mocha, a place in his dominions which till then was only a village.

This trade was at firſt inconſiderable; conſiſting principally in myrrh, incenſe, aloes, balm of Mecca, ſome aromatics, and medicinal drugs. Theſe articles, the exportation of which is continually retarded by exorbitant impoſts, and does not exceed at preſent 30,625 l. were at that time more in repute than they have been ſince: but muſt have been always of little conſequence. Soon after a great change enſued from the introduction of coffee.

Though this article is generally uſed in the Arabian entertainments, none but the rich citizens have the pleaſure of taſting the berry itſelf. The generality are obliged to content themſelves with the ſhell and the huſk of this valuable production. Theſe remains, ſo much deſpiſed, make a liquor of a pretty clear colour, which has a taſte of coffee without its bitterneſs and ſtrength. Theſe articles may be had at a low price at Betelfagui, which is the general market for them. Here likewiſe is ſold all the coffee which comes out of the country by land. The reſt is carried to Mocha, which is 35 leagues diſtant, or to the nearer ports of Lohia or Hodeida, from whence it is tranſported in ſmall veſſels to Jodda. The Egyptians fetch it from the

Arabia. the last mentioned place, and all other nations from the former.

The quantity of coffee exported may be estimated at twelve millions five hundred and fifty thousand weight. The European companies take off a million and a half; the Persians three millions and a half; the fleet from Suez six millions and a half; Indostan, the Maldives, and the Arabian colonies on the coast of Africa, fifty thousand; and the caravans a million.

As the coffee which is bought up by the caravans and the Europeans is the best that can be procured, it costs about 8¼d. a pound. The Persians, who content themselves with that of an inferior quality, pay no more than about 6¼d. a pound. The Egyptians purchase it at the rate of about 8d. their cargoes being composed partly of good and partly of bad coffee. If we estimate coffee at about 7⅜d. a pound, which is the mean price, the profits accruing to Arabia from its annual exportation will amount to 384,343 l. 15 s. This money does not go into their coffers; but it enables them to purchase the commodities brought from the foreign markets to their ports of Jodda and Mocha.

Mocha receives from Abyssinia, sheep, elephants teeth, musk, and slaves. It is supplied from the eastern coast of Africa with gold, slaves, amber, and ivory; from the Persian Gulph, with dates, tobacco, and corn; from Surat, with a vast quantity of coarse, and a few fine linens; from Bombay and Pondicherry, with iron, lead, and copper, which are carried thither from Europe; from Malabar, with rice, ginger, pepper, Indian saffron, with coire, cardamom, and also with planks; from the Maldives, with gum, benzoin, aloes-wood, and pepper, which these islands take in exchange; from Coromandel, with 400 or 500 bales of cottons, chiefly blue. The greatest part of these commodities, which may fetch 262,500l. are consumed in the interior part of the country. The rest, particularly the cottons, are disposed of in Abyssinia, Socotora, and the eastern coast of Africa.

None of the branches of business which are managed at Mocha, as well as throughout all the country of Yaman, or even at Sanaa the capital, are in the hands of the natives. The extortions with which they are perpetually threatened by the government deter them from interfering in them. All the warehouses are occupied by the Banians of Surat or Guzaret, who make a point of returning to their own country as soon as they have made their fortunes. They then resign their settlements to merchants of their own nation, who retire in their turn, and are succeeded by others.

The European companies, who enjoy the exclusive privilege of trading beyond the Cape of Good Hope, formerly maintained agents at Mocha. Notwithstanding it was stipulated by a solemn capitulation, that the imposts demanded should be rated at two and a quarter *per cent.* they were subject to frequent extortions: the governor of the place insisting on their making him presents, which enabled him to purchase the favour of the courtiers, or even of the prince himself. However, the profits they obtained by the sale of European goods, particularly clothes, made them submit to these repeated humiliations. When these several articles were furnished by Grand Cairo, it was then impossible to withstand the competition, and the fixed settlements were therefore given up.

The trade was carried on by ships that failed from Europe with iron, lead, copper, and silver, sufficient to pay for the coffee they intended to buy. The supercargoes, who had the care of these transactions, settled the accounts every time they returned. These voyages, which at first were pretty numerous and advantageous, have been successively laid aside. The plantations of coffee, made by the European nations in their colonies, have equally lessened the consumption and the price of that which comes from Arabia. In process of time, these voyages did not yield a sufficient profit to answer the high charges of undertaking them on purpose. The companies of England and France then resolved, one of them to send ships from Bombay, and the other from Pondicherry, to Mocha, with the merchandise of Europe and India. They even frequently had recourse to a method that was less expensive. The English and French visit the Red sea every year. Tho' they dispose of their merchandise there to good advantage, they can never take in cargoes from thence for their return. They carry, for a moderate freight, the coffee belonging to the companies who lade the vessels with it, which they dispatch from Malabar and Coromandel to Europe. The Dutch company, who prohibit their servants from fitting out ships, and who send no vessels themselves, to the gulph of Arabia, are deprived of the share they might take in this branch of commerce. They have also given up a much more lucrative branch, that of Jodda.

Jodda is a port situated near the middle of the gulph of Arabia, 20 leagues from Mecca. The government there is of a mixed kind: the grand Signior and the Xeriff of Mecca share the authority and the revenue of the customs between them. These imposts are levied upon the Europeans at the rate of 8 *per cent.* and upon other nations at 13. They are always paid in merchandise, which the managers oblige the merchants of the country to buy at a very dear rate. The Turks, who have been driven from Aden, Mocha, and every part of the Yaman, would long ago have been expelled from Jodda, if there had not been room to apprehend that they might revenge themselves in such a manner as to put an end to their pilgrimages and commerce.

203 Coins. The coins, which are current at Mocha, the principal port of the Red Sea, are dollars of all kinds; but they abate five per cent. on the pillar dollars, because they are reckoned not to be the purest silver, and the dollar weight with them is 17 drams 14 grains. All their coins are taken by weight, and valued according to their pureness. The gold coins current here are ducats of Venice, Germany, Turkey, Egypt, &c. The comasses are a small coin, which are taken at such a price as the government sets on them; and they keep their accounts in an imaginary coin, called *cabeers*, of which 80 go to a dollar. For an account of the ancient coins called *dinars* and *dirhems*, see these two articles.

Gum ARABIC. See Gum.

Arabia ‖ Arabici

ARABICI, a sect who sprung up in Arabia; about the year 207, whose distinguishing tenet was, that the soul died with the body, and also rose again with it.

Eusebius, lib. vi. c. 38. relates, that a council was called to stop the progress of this rising sect; and that Origen assisted at it; and convinced them so thoroughly of their error that they abjured it.

ARABIS, BASTARD TOWER-MUSTARD: A genus of the siliquosa order, belonging to the tetradynamia class of plants; and in the natural method ranking under the 39th order, *Siliquosæ*. The generic mark consists in 4 nectiferous glands which lie on the inside of each leaf of the calyx. There are 8 species; but none of them remarkable for their beauty or other properties. Only one of these, the thaliana or mouse-ear, is a native of Britain. It is a low plant, seldom rising more than four or five inches high, branching on every side, having small white flowers growing alternately, which have each four petals in form of a cross, that are succeeded by long slender pods filled with small round seeds. It grows naturally on sandy ground or old walls. Sheep are not fond of it, and swine refuse it.

ARABISM, ARABISMUS, an idiom or manner of speaking peculiar to the Arabs or the Arabic language.

ARABIST, a person curious of, and skilled in, the learning and languages of the Arabians: such were Erpenius and Golius. The surgeons of the 13th century are called *Arabists* by Severinus.

ARABLE LANDS, those which are fit for tillage, or which have been formerly tilled.

ARACAN, the capital of a small kingdom to the north-east of the Bay of Bengal, situated in E. Long. 93. 0. N. Lat. 20. 30. It has the conveniency of a spacious river, and a harbour large enough to hold all the ships in Europe. It is said by Schouten to be as large as Amsterdam; but the houses are slight, being made with palm-trees and bomboo-canes, and covered with leaves of trees. They are seldom above six feet high, but have many windows or air-holes. But the people of the highest rank are much better accommodated. They have no kitchens, chimneys, or cellars, which oblige the women to dress the victuals out of doors. Some of the streets are on the ridges of rocks, wherein are a great many shops. Their orchards and gardens contain all the fruit common to the Indies, and their trees are green all the year. Their common drink is toddy; which is the sap of the cocoa-tree, and when new will intoxicate like wine, but soon grows sour. Elephants and buffaloes are very numerous here, and are made use of instead of horses. They have plenty of provisions, and but little trade: for when Mr Channoch was here in 1686, with six large ships, there was nothing to be had in the way of commerce; and yet the country produces lead, tin, stick-lac, and elephants teeth. The Mogul's subjects come here to purchase these commodities; and sometimes meet with diamonds, rubies, and other precious stones. They were formerly governed by a king of their own, called the king of the *White Elephant;* but this country has been conquered by the king of Pegu. They pay little or no regard to the chastity of their women, and the common sailors take great liberties among them. Their religion is Paganism; and the idols, temples, and priests are very numerous. The dress of the better sort is very slight, for it consists chiefly of a piece of white cotton over their arms, breast, and belly, with an apron before. The complexion of the women is tolerable; they wear thin flowered guaze over their breast and shoulders, and a piece of cotton, which they roll three or four times round their waist, and let it hang as low as their feet. They curl their hair, and put glass rings in their ears, and stretch them of a monstrous length. On their arms and legs they have hoops of copper, ivory, silver, &c. The country produces great quantities of rice, and the water is good. Their flocks of sheep and herds of cattle are also numerous near Aracan; but what they say of the towns and villages, with which the country is pretended to be overspread, may be doubted. Captain Hamilton affirms, that there are but few places inhabited, on account of the great number of wild elephants and buffaloes, which would destroy the fruits of the ground; and that the tigers would destroy the tame animals. There are some islands near the sea, inhabited by a few miserable fishermen, who can just keep themselves from starving, tho' they are out of the reach of oppression. The rich burn the dead bodies; but the poor, who are not able to buy wood, throw them into the river.

ARACHIS, in botany: A genus of the diadelphia order, belonging to the decandria class of plants; and, in the natural method, ranking under the 32d order, *Papilionaceæ*. There is only one species, the hypogæa, an annual plant, and a native of Brasil and Peru. The stalks are long, trail upon the ground, and are furnished with winged leaves, composed of four hairy lobes each. The flowers are produced singly on long peduncuis; they are yellow, of the pea kind, and each contains ten awl-shaped stamina, nine of which are tied together, and the upper one stands off. In the centre is an awl-shaped stylus, crowned with a simple stigma. The germen is oblong, and becomes an oval oblong pod, containing two or three oblong blunt seeds.—This plant is cultivated in all the American settlements for the seeds, which make a considerable part of the food of the slaves. The manner of perfecting them is very singular: for as the flowers fall off, the young pods are forced into the ground by a natural motion of the stalks, and there they are entirely buried, and not to be discovered without digging for them; whence they have taken the name of *ground nuts*.

ARACHNE, in fabulous history, a young maid of Lydia, said to have been the inventress of spinning. She is fabled to have been so skilful in this art, as to challenge Minerva at it; who tore her work, and struck her; which disgrace driving her to despair, she hanged herself. Minerva, from compassion, brought her to life, and transformed her into a spider, which still employs itself in spinning.

ARACHNOIDES, in anatomy, an appellation given to several membranes; as the tunic of the crystalline humour of the eye, the external lamina of the pia mater, and one of the coverings of the spinal marrow.

ARACK, ARRACK, or RACK, a spirituous liquor imported from the East Indies, used by way of dram and in punch.

The word *arack*, according to Mr Lockyer, is an Indian name for strong waters of all kinds; for they call our spirits and brandy *English arack*. But what we understand by the name *arack*, he affirms is really no other than a spirit procured by distillation from a vegetable juice called *toddy*, which flows by incision out of the cocoa-nut tree, like the birch-juice procured among us. The toddy is a pleasant drink by itself, when new, and purges those who are not used to it; and, when stale, it is heady, and makes good vinegar.

The

Arack.

The English at Madrass use it as leaven to raise their bread with.

Others are of opinion, that the arack, or arrack, is a vinous spirit obtained by distillation, in the East Indies, from rice or sugar, fermented with the juice of cocoa-nuts.

The Goa arack is said to be made from the toddy, the Batavia arack from rice and sugar; and there is likewise a kind of shrub from which arack is made.

Goa and Batavia are the chief places for arack.—At Goa there are divers kinds; single, double, and treble distilled. The double distilled, which is that commonly sent abroad, is but a weak spirit in comparison with Batavia arack; yet, on account of its peculiar and agreeable flavour, is preferred to all the other aracks of India. This flavour is attributed to the earthen vessels which they use at Goa to draw the spirit; whereas at Batavia they use copper stills.

The Parier arack made at Madrass, and the Columbo and Quilone arack at the other places, being fiery hot spirits, are little valued by the Europeans, and therefore rarely imported; though highly prized among the natives. In the best Goa arack, the spirits of the cocoa-juice do not make above a sixth or eighth part.

The manner of making the Goa arack is this: The juice of the trees is not procured in the way of tapping, as we do; but the operator provides himself with a parcel of earthen pots, with bellies and necks like our ordinary bird-bottles: he makes fast a number of these to his girdle, and any way else that he commodiously can about him. Thus equipped, he climbs up the trunk of a cocoa tree; and when he comes to the boughs, he takes out his knife, and cutting off one of the small knots or buttons, he applies the mouth of the bottle to the wound, fastening it to the bough with a bandage; in the same manner he cuts off other buttons, and fastens on his pots, till the whole number is used: this is done in the evening, and descending from the tree, he leaves them till the next morning; when he takes off the bottles, which are mostly filled, and empties the juice into the proper receptacle. This is repeated every night, till a sufficient quantity is produced; and the whole being then put together, is left to ferment, which it soon does. When the fermentation is over, and the liquor or wash is become a little tart, it is put into the still, and a fire being made, the still is suffered to work as long as that which comes over has any considerable taste of spirit.

The liquor thus procured is the low wine of arack; and this is so poor a liquor, that it will soon corrupt and spoil, if not distilled again, to separate some of its phlegm; they therefore immediately after pour back this low wine into the still, and rectify it to that very weak kind of proof-spirit, in which state we find it. The arack we meet with, notwithstanding its being of a proof-test, according to the way of judging by the crown of bubbles, holds but a sixth, and sometimes but an eighth, part of alcohol or pure spirit; whereas our other spirits, when they show that proof, are generally esteemed to hold one half pure spirit. *Shaw's Essay on Distilling.*

There is a paper of observations on arack, in the *Melanges d'Histoire Natur.* tome v. p. 302. By fermenting, distilling, and rectifying the juice of the American maple, which has much the same taste as that of the cocoa, the author says, he made arack not in the least inferior to any that comes from the East Indies; and he thinks the juice of the sycamore and of the birch trees would equally answer the end.

Arack, Arad.

Besides the common sorts of Goa and Batavia arack, there are two others less generally known; these are the bitter arack and the black arack.

By stat. 11th Geo. I. c. 30. arack on board a ship within the limits of any port of Great Britain, may be searched for and seized, together with the package; or if found unshipping or unshipped, before entry, may be seized by the officers of excise, in like manner as by the officers of the customs.—Upon an excise-officer's suspicion of the concealment of arack, and oath made of the grounds of such suspicion before the commissioners or a justice of peace, they may empower him to enter such suspected places, and seize the liquors, with the casks, &c. If the officers are obstructed, the penalty is 100l.

Arack is not to be sold but in warehouses, entered as directed in the 6th of Geo. I. c. 21. upon forfeiture, and the casks, &c. If permits are not returned which are granted for the removal of arack, or if the goods are not sent away within the time limited, the penalty is treble the value. If the permits are not returned, and the decrease is not found to be sufficient, the like quantity is forfeited. Permits are not to be taken out but by direction in writing of the proprietor of the stock, or his known servant, upon forfeiture of 50l. or three months imprisonment.

By stat. 9th Geo. II. c. 35. if arack is offered for sale without a permit, or by any hawker, pedlar, &c. with a permit, the person to whom it is offered may seize and carry it to the next warehouse belonging to the customs or excise, and bring the person offering the same before any justice of the peace, to be committed to prison, and prosecuted for the penalties incurred by such offence. The person seizing such goods may prosecute in his own name; and on recovery is entitled to one-third part of the gross produce of the sale: and the commissioners are, if desired, upon a certificate from the justice of the offender's being committed to prison, to advance to the seizer 15s. per gallon for the arack so seized.

Arack (except for the use of seamen, two gallons each) found in any ship or vessel arrived from foreign parts, at anchor, or hovering within the limits of any port, or within two leagues of the shore; and not proceeding on her voyage (unless in case of unavoidable necessity and distress of weather, notice whereof must be given to the collector or chief officer of the port upon the ship's arrival), is forfeited, with the boxes, casks, or other package, or the value thereof.

Arack is also the name of a spirituous liquor made by the Tartars of Tungusia, of mare's milk, left to sour, and afterwards distilled twice or thrice between two earthen pots closely stopped, whence the liquor runs through a small wooden pipe. It is more intoxicating than brandy.

ARAD (anc. geog.), a city lying to the south of Judah and the land of Canaan, in Arabia Petræa. The Israelites having advanced towards the land of Canaan (Numb. xxi. 1.), the king of Arad opposed their passage, defeated them, and took a great booty from them; but they destroyed his country as soon as they became

became masters of the land of Canaan (Numb. xxxiii.) Arad was rebuilt, and Eusebius places it in the neighbourhood of Kades, at the distance of 20 miles from Hebron. The Israelites, in their passage through the wilderness, having departed from Sepher, came to Arad, and from thence to Makkelath.

ARADUS (anc. geog.), an island between the borders of Phœnicia and Seleucis, at the distance of 20 stadia from a dangerous coast: all of it a rock surrounded by the sea, in compass seven stadia; and forming a very powerful city and republic. It is now called *Ronad;* but not a single wall is remaining of all that multitude of houses which, according to Strabo, were built with more stories than even those of Rome. The liberty enjoyed by the inhabitants had rendered it very populous; and it subsisted by a naval commerce, manufactures, and arts. As present the island is deserted; nor has tradition even retained the memory of a spring of fresh water in its environs, which the people of Aradus discovered at the bottom of the sea, and from which they drew water in time of war by means of a leaden bell and a leathern pipe fitted to its bottom.

ARÆ PHILÆNON, or PHILÆNORUM (Strabo); to the south of the Syrtis major; but in Peutinger; more westerly, to the south almost of the Syrtis Minor. In Strabo's time, the altars were not extant, but a village of the same name stood on the spot. On a dispute about limits, between the Cyrenians and Carthaginians, it was agreed that two of each people should set out on the same day, and that where they should happen to meet, there the limits of both should be fixed. The Philæni, two brothers, Carthaginians, undertook it for Carthage: these, after having advanced a great many miles into the territory of the Cyreneans, were met by their antagonists; who, enraged at their being beforehand with them so far, gave them the option of either returning back, or of being buried alive on the spot. Like zealous patriots, they chose the latter; and there the Carthaginians raised two altars in honour of the Philæni. (Sallust, Valerius Maximus.)

ARÆOMETER, an instrument wherewith to measure the density or gravity of fluids.

The aræometer, or water-poise, is usually made of glass; consisting of a round hollow ball, which terminates in a long slender neck hermetically sealed at top; there being first as much running mercury put into it as will serve to balance or keep it swimming in an erect position.

The stem is divided into degrees (as represented Plate XXXIV. fig. 23.); and by the depth of its descent into any liquor, the lightness of that liquor is concluded: for that fluid in which it sinks least must be heaviest; and that in which it sinks lowest, lightest.

M. Homberg has invented a new aræometer, described in Phil. Transact. N° 262. thus: *A* is a glass bottle or matrass, with so slender a neck that a drop of water takes up in it about five or six lines, or half of an inch. Near that neck is a small capillary tube *D*, about six inches long, and parallel to the neck.—To fill the vessel, the liquor is poured in at the mouth *B*, (which is widened to receive a tunnel), till it run out at *D*, that is, till it rise in the neck to the mark *C*, by which means you have always the same bulk or quantity of liquor; and consequently, by means of the balance, can easily tell, when different liquors fill it, which weighs most, or is most intensely heavy.

Some regard, however, is to be had in these trials to the season of the year and degree of heat and cold in the weather; because some liquors rarefy with heat and condense with cold more than others, and accordingly take up more or less room.

By means of this instrument, the ingenious author has made a table to show the different weights of the same bulk of the most considerable chemical liquors both in summer and winter, as follows:

The aræometer full of	Weighed in summer. *oz. dr. gr.*		in winter. *oz. dr. gr.*
Quicksilver, -	11 00 06	-	11 00 32
Oil of tartar, -	01 03 08	-	01 03 31
Spirit of urine, -	01 00 32	-	01 00 43
Oil of vitriol, -	01 03 58	-	01 04 03
Spirit of nitre, -	01 01 40	-	01 01 70
Spirit of salt, -	01 00 39	-	01 00 47
Aquafortis, -	01 01 38	-	01 01 55
Vinegar, -	00 07 55	-	00 07 60
Spirit of wine, -	00 06 47	-	00 06 61
River water, -	00 07 53	-	00 07 57
Distilled water, -	00 07 50	-	00 07 54

The instrument itself weighed, when empty, one dram twenty-eight grains. See HYDROMETER.

ARÆOPAGUS. See AREOPAGUS.

ARÆOSTYLE, in architecture, a term used by Virtruvius, to signify the greatest interval which can be made between columns.

ARÆOTICS, in medicine, remedies which rarefy the humours, and render them easy to be carried off by the pores of the skin.

ARAF, among the Mahometans. See ALARAF.

ARAFAH, the ninth day of the last month of the Arabic year, named *Dhoulhegiat;* on which the pilgrims of Mecca perform their devotions on a neighbouring mountain called *Arafat.* The Mahometans have a very great veneration for this mountain, because they believe that Adam and Eve, after they were banished out of Paradise, having been separated from each other during 120 years, met afterwards on this mountain.

ARAFAT, or GIBEL EL ORPHAT, *the mountain of knowledge,* a mountain in Arabia, near Mecca. The Mahometans say this was the place where Adam first met with and knew his wife Eve after their expulsion from Paradise. This mountain not being large enough to contain all the devotees that come annually in pilgrimage to Mecca, stones are set up all round it to show how far it reaches. The pilgrims are clad in robes of humility and mortification, with their heads uncovered. They seem to be very much affected; for the tears flow down their cheeks, and they sob and sigh most bitterly, begging earnestly for remission of sins, and promising to lead a new life. They continue here about four or five hours, and at half an hour after sunset they all decamp to perform a religious duty called *Asham nomas.* After this, they all receive the honourable title of *hadgees,* which is conferred upon them by the imam or priest. This being pronounced, the trumpet sounds, and they all return to Mecca.

ARAGON. See ARRAGON.

ARAL, a great lake in the kingdom of Khowarazm, Arahum, Aralia. razm, lying a little to the eastward of the Caspian sea. Its length from north to south is said to be near 150 miles, and its breadth from east to west about 70. The shore on the west side is high and rocky, and destitute of good water: yet there are abundance of wild horses, asses, antelopes, and wolves; as also a fierce creature called a *jolbart*, which the Tartars say is of such a prodigious strength as to carry off a horse. It is surprising that this lake should be quite unknown to geographers till within these few years. Several great rivers, which were supposed to run into the Caspian sea, are now known to fall into this lake, particularly the Sihun or Sirr, and the Gihun or Amo, so often mentioned by the Oriental historians. This lake, like the Caspian sea, has no visible outlet. Its water is also very salt; and for that reason is conveyed by the neighbouring inhabitants by small narrow canals into sandy pits, where the heat of the sun, by exhaling the water, leaves them a sufficient quantity of salt. The same kinds of fish are found in Aral that are found in the Caspian sea. The former is also called the *Lake of Eagles*.

ARAHUM, or HARAHUM, in ancient writers, denotes a place consecrated or set apart for holy purposes. Hence the phrase *in araho jurare*, or *conjurare*, "to make oath in the church;" because, by the Ripuarian laws, all oaths were to be taken in the church on the relics of the saints.

ARALIA, the ANGELICA TREE; A genus of the pentagynia order, belonging to the pentandria class of plants; and in the natural method ranking under the 46th order, *Hederaceæ*. The essential characters are: The involucrum is an umbella; the calyx is quinquedentated, and above the fruit; the corolla consists of five petals; and the berry has five seeds.

Species. There are five species of aralia, all natives of the Indies. The principal are, 1. The nudicaulis, having a naked stalk. This grows three or four feet high; the leaves have two large trifoliate lobes, which are sawed on their edges. The flower-stalks arise between these, immediately from the root, and are terminated by round umbels of small four-leaved flowers of a whitish colour. The roots of this species were brought over from North America, and sold here for sarsaparilla, and it is still used as such by the inhabitants of Canada; though it is very different from the true sort. 2. The spinosa, with a prickly stem, is a very ornamental shrub, and a native of Virginia. The height to which this tree will grow, if the soil and situation wholly agree with it, is about twelve feet; and the stem, which is of a dark brown colour, is defended by sharp spines, which fall off; even the leaves, which are branching, and composed of many wings, and are of a pleasant green colour, have these defenders, which are both crooked and strong, and stand as guards to them till the leaves fall off in the autumn. The flowers are produced in large umbels from the ends of the branches: They are of a greenish yellow colour; and their general characters indicate their structure. They make their appearance the end of July or beginning of August; but are not succeeded by ripe seeds in our gardens.

Propagation and culture of the spinosa. This tree will what gardeners call *spawn*; i. e. after digging among the roots, young plants will arise, the broken roots sending forth fresh stems; nay, if the roots are planted in a warm border, and shaded in hot weather, they will grow; but if they are planted in pots, and assisted by a moderate warmth of dung, or tanner's bark, they will be pretty sure of success; so that the propagation of this tree is very easy. But the general method of propagating it, and by which the best plants may be had, is from seeds, which must be procured from America, for they do not ripen in Britain; and, after having obtained them, they must be managed in the following manner: The time that we generally receive them is in the spring; so that against their coming we must be furnished with a sufficient number of large pots. These, when the seeds are come, must be filled with fine mould, which, if taken from a rich border, will do very well. The seeds must be sown in these pots as soon as possible after their arrival, hardly half an inch deep, and then the pots should be plunged in a warm place their whole depth in the soil. Care must be taken to break the mould in the pots, and water them as often as it has a tendency to crust over; and if they are shaded in hot weather, the plants will frequently come up the first summer. But as this does not often happen, if the young plants do not appear by midsummer, the pots should be taken and plunged in a shady place; nay, if they should, there will be still more occasion for this being done; for they will flourish after that better in the shade; and the design of plunging them in a warm place at first was only with a view of setting the powers of vegetation at work, that, having natural heat, artificial shade also may be given them, and water likewise, the three grand necessaries for the purpose. The pots, whether the plants are come up in them or not, should be removed into shelter in October, either into a greenhouse, some room, or under an hotbed-frame; and in the spring, when all danger of frost is over, they should be plunged into the natural ground their own depth in a shady place. Those that were already come up will have shot strong by the autumn following; and if none of them have appeared, they will come up this spring; and whether they are young seedlings, or small plants of a former summer's growth, they must be constantly kept clean of weeds, and duly watered in the time of drought; and this care must be observed until the autumn. In October they must again be removed into shelter, either into a greenhouse, &c. as before, or fixed in a warm place, and hooped, that they may be covered with mats in frosty weather. In the latter end of March following, they should be planted in the nursery way, to gain strength before they are finally planted out. The ground for this purpose, besides the natural shelter, should have a reed hedge, or something of the like nature, the more effectually to prevent the piercing winds from destroying the young plants. In this snug place the plants may be set in rows: in each of which rows furze-bushes should be stuck the whole length; and all these together will ensure their safety. But here one caution is to be observed; not to stick the furze so thick, but that the plants may enjoy the free air in mild weather, and not to take them away too early in the spring, lest, being kept warm the whole winter, and being deprived of their protection, a cutting frost should happen, as it sometimes does even in April, and destroy them. Weeding and watering in dry weather must be their summer's care. They may be stuck again with furze-bushes in the winter; though it will not be necessary

Aralia.

neceſſary to do it in ſo cloſe a manner; and with this care, ſtill diminiſhing in proportion the number of furze-buſhes, they may continue for three or four years, when they may be planted out into the warmeſt parts of the plantation. With this management theſe plants will be inured to bear our winters in well-ſheltered places.

The ſpines which grow on the branches and the leaves admoniſh us, for our own ſafety, not to plant this tree too near the ſides of frequented walks; and the conſideration of the nature of the tree, which is rather tender at the beſt, directs us (if we have a mind to retain the ſort) to plant it in a warm and well-ſheltered ſituation; where the piercing froſts, come from what point they will, will loſe their edge: for without this, they will be too tender to ſtand the teſt of a ſevere winter; though it has often happened, that after the main ſtem of the plant has been deſtroyed, it has ſhot out again from the root, and the plant by that means been both increaſed and preſerved.

ARAM, or *Aramæa Regio*, (anc. geog.) the Hebrew name of Syria, ſo called from Aram the ſon of Shem, (Moſes, Joſephus.)

Aram Beth-Rehob, (anc. geog.) was that part of Syria lying to the north of Paleſtine; becauſe Rehob was its boundary towards that quarter, (Moſes); allotted to the tribe of Aſher, (Judges); where it joins Sidon, (Joſhua).

Aram-Dammeſek, or Syria Damaſcena, (anc. geog.) a principal part of Syria, and more powerful than the reſt, (2 Sam.) taking its name from Damaſcus, the principal city.

Aram-Maacha, (anc. geog.) a diſtrict of Syria, at the foot of mount Hermon, (2 Samuel, 1 Chronicles); on the borders of the half tribe of Manaſſeh, on the other ſide the Jordan, called the coaſt of *Maachathi*, (Moſes, Joſhua.)

Aram-Naharaim, (anc. geog.) i. e. Aram, or Syria of the Rivers, or Meſopotamia, ſituated between the Euphrates and Tigris; which is the reaſon of the name.

Aram-Soba, or *Zoba*, (anc. geog.) which David conquered, was a country near the Euphrates, where afterwards Palmyra ſtood: the Euphrates bounded it on the eaſt, as the land of Canaan and Syria Damaſcena did on the weſt, (2 Samuel.)

ARAMONT, a town of Languedoc in France, ſeated on the river Rhone. E. Long. 4. 52. N. Lat. 43. 54.

ARANEA, the SPIDER; a genus of inſects belonging to the order of aptera, or inſects without wings.

All the ſpecies of ſpiders have eight legs, with three joints in each, and terminating in three crooked claws; eight eyes, two before, two behind, and the reſt on the ſides of the head. In the fore-part of the head, at the mouth, there is a pair of ſharp crooked claws or forceps: theſe ſtand horizontally; and, when not exerted for uſe, are concealed in two caſes contrived for their reception, in which they fold like a claſp-knife, and there lie between two rows of teeth. A little below the point of each claw, there is a ſmall hole, through which Liewenhoeck ſuppoſes the ſpider emits a kind of poiſon (A.) Theſe claws are the weapons with which they kill flies, &c. for their food. The belly or hinder part is ſeparated from the head and breaſt by a ſmall thread-like tube. The ſkin or outer ſurface is a hard poliſhed cruſt.

Spiders have five tubercles or nipples at the extremity of the belly, whoſe apertures they can enlarge or contract at pleaſure. It is through theſe apertures that they ſpin a gluey ſubſtance with which their bellies are full. They fix the end of their threads by applying theſe nipples to any ſubſtance, and the thread lengthens in proportion as the animal recedes from it. They can ſtop the iſſuing of the threads by contracting the nipples, and re-aſcend by means of the claws on their feet, much in the ſame manner as ſome men warp up a rope. When the common houſe-ſpider begins her web, ſhe generally chooſes a place where there is a cavity, ſuch as the corner of a room, that ſhe may have a free paſſage on each ſide, to make her eſcape in caſe of danger. Then ſhe fixes one end of her thread to the wall, and paſſes on to the other ſide, dragging the thread along with her (or rather the thread follows her as ſhe proceeds), till ſhe arrives at the other ſide, and there fixes the other end of it. Thus ſhe paſſes and repaſſes, till ſhe has made as many parallel threads as ſhe thinks neceſſary for her purpoſe. After this, ſhe begins again and croſſes theſe by other parallel threads, which may be named the *woof*. Theſe are the toils or ſnares which ſhe prepares for entangling flies, and other ſmall inſects, which happen to light upon it. But, beſides this large web, ſhe generally weaves a ſmall cell for herſelf, where ſhe lies concealed watching for her prey. Betwixt this cell and the large web ſhe has a bridge of threads, which, by communicating with the threads of the large one, both give her early intelligence when any thing touches the web, and enables her to paſs quickly in order to lay hold of it. There are many other methods of weaving peculiar to different ſpecies of ſpiders; but as they are all intended

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(A) Dr Mead, in his Eſſay on Poiſons, diſſents wholly from this opinion, having never been able, on repeated examinations, to diſcover any ſuch opening, not even in the claws of the largeſt foreign ſpiders; which being above fifty times bigger than any of the European ſpiders, would more eaſily have afforded a view of this opening, if nature had allotted any to this part of the animal. Beſides, repeated obſervations alſo convinced him that nothing dropped out of the claws, which were always dry while the ſpider bit any thing, but that a ſhort white proboſcis was at the ſame inſtant thruſt out of the mouth, which inſtilled a liquor into the wound. And the ſame author obſerves, that the quantity of liquor emitted by our common ſpiders when they kill their prey, is viſibly ſo great, and the wounding weapons ſo minute, that they ſhould contain but a very inconſiderable portion thereof, if it were to be diſcharged that way. Baker's Microſcope, p. 196. Spiders frequently caſt their ſkins, which may be found in the webs perfectly dry and tranſparent; and from ſuch ſkins the forceps, or claws, for they are always ſhed with the ſkins, may eaſier be ſeparated, and examined with much greater exactneſs, than in the common ſpider while living.

Aranea.

ed for the ſame purpoſe, it is needleſs to give particular deſcriptions of them.

That darting-out of long threads, however, which has been obſerved by naturaliſts, and by means of which ſome ſpecies can convey themſelves to great diſtances, deſerves particular notice.

Dr Liſter tells us, that attending cloſely to a ſpider weaving a net, he obſerved it ſuddenly to deſiſt in the mid-work: and turning its tail to the wind, it darted out a thread with the violence and ſtream we ſee water ſpout out of a jet: this thread, taken up by the wind, was immediately carried to ſome fathoms long; ſtill iſſuing out of the belly of the animal. By-and-by the ſpider leaped into the air, and the thread mounted her up ſwiftly. After this diſcovery, he made the like obſervation in near thirty different ſorts of ſpiders; and found the air filled with young and old, ſailing on their threads, and doubtleſs ſeizing gnats and other inſects in their paſſage, their being often manifeſt ſigns of ſlaughter, legs and wings of flies, &c. on theſe threads, as well as in their webs below. Dr Hulſe diſcovered the ſame thing about the ſame time.

Dr Liſter thinks there is a fair hint of the darting of ſpiders in Ariſtotle, Hiſt. An. lib. ix. cap. 39. and in Pliny, lib. x. cap. 74. But with regard to their ſailing, the ancients are ſilent, and he thinks it was firſt ſeen by him. He alſo obſerves of thoſe ſailing ſpiders, that they will often dart, not a ſingle thread only, but "a whole ſheaf at once, conſiſting of many filaments; yet all of one length, all divided each from the other, and diſtinct until ſome chance either ſnap them off or entangle them. But for the moſt part you may obſerve that the longer they grow, the more they ſpread, and appear to a diligent obſerver like the numerous rays in the tail of a blazing ſtar. As for that which carries them away in the air, ſo ſwift off-hand, it is (as I have already hinted) partly their ſudden leap; partly the length and number of the threads projected, the ſtream of the air and wind beating more forcibly upon them; and partly the poſture and management of their feet, which, at leaſt by ſome ſort of them, I have obſerved to have been uſed very like wings or oars, the ſeveral legs (like our fingers) being ſometimes cloſe joined, at other times opened, again bent, extended, &c. according to the ſeveral neceſſities and will of the ſailor. To fly they cannot be ſtrictly ſaid, they being carried into the air by external force; but they can, in caſe the wind ſuffer them, ſteer their courſe, and perhaps mount and deſcend at pleaſure: and to the purpoſe of rowing themſelves along the air, it is obſervable that they ever take their flight backwards; that is, their head looking a contrary way, like a ſculler upon the Thames. It is ſcarce credible to what height they will mount; which yet is preciſely true, and I think eaſily to be obſerved by one that ſhall fix his eye ſome time on any part of the heavens, the white webs, at a vaſt diſtance, very diſtinctly appearing from the azure ſky; but this is in autumn only, and that in very fair and calm weather." In a letter to Mr Ray, dated January 1670, ſpeaking of the height ſpiders are able to fly to, he ſays, "Laſt October, &c. I took notice, that the air was very full of webs; I forthwith mounted to the top of the higheſt ſteeple on the Minſter (in York), and could there diſcern them yet exceeding high above me."

He further obſerves, that they not only thus ſhoot their threads upward, and mount with it in a line almoſt perpendicular; they alſo project them in a line parallel to the horizon, as may be ſeen by their threads running from one wall to another in a houſe, or from one tree to another in the field, and even from wall to wall acroſs gardens of conſiderable extent.

The matter of which the ſpider's threads are formed, we have obſerved, is a viſcid juice, elaborated in the body of the animal, and emitted from papillæ ſituated at the extremity of the belly; which papillæ are furniſhed with numerous apertures that do the buſineſs of wire-drawers, as it were, in forming the threads. Of theſe apertures Mr. Reaumur obſerves, there are enough in the compaſs of the ſmalleſt pin's head to yield a prodigious quantity of diſtinct threads. The holes are perceived by their effects: take a large garden-ſpider ready to lay its eggs, and applying the finger on a part of its papillæ, as you withdraw that finger it will take with it an amazing number of different threads. M. Reaumur has often counted 70 or 80 with a microſcope, but has perceived that there were infinitely more than he could tell. In effect, if he ſhould ſay that each tip of a papillæ furniſhed a thouſand, he is perſuaded he would ſay much too little. The part is divided into an infinity of little prominences, like the eyes of a butterfly, &c. Each prominence no doubt makes its ſeveral threads; or rather between the ſeveral protuberances there are holes that give vent to threads; the uſe of the protuberances, in all probability, being to keep the threads at their firſt exit, before they are yet hardened by the air, aſunder. In ſome ſpiders thoſe protuberances are not ſo ſenſible; but in lieu thereof there are tufts of hair which may ſerve the ſame office, viz. to keep the threads a-part. Be this as it will, there may threads come out at above a thouſand different places in every papillæ; conſequently the ſpider, having five papillæ, has holes for above five thouſand threads.

Such is the tenuity of the threads in the larger ſort of ſpiders. But if we examine the young produced by thoſe, we ſhall find that they no ſooner quit their egg than they begin to ſpin. Indeed their threads can ſcarce be perceived, but the webs may: they are frequently as thick and cloſe as thoſe of houſe ſpiders; and no wonder, there being often four or five hundred little ſpiders concurring in the ſame work. How minute muſt their holes be! the imagination can ſcarce conceive that of their papillæ! The whole ſpider is perhaps leſs than a papilla of the parent which produced it. But there are even ſome kinds of ſpiders ſo ſmall at their birth, that they are not viſible without a microſcope. There are uſually found an infinity of theſe in a cluſter, and they only appear like a number of red points: And yet there are webs found under them, though well nigh imperceptible. What muſt be the tenuity of one of theſe threads? Mr Liewenhoek has computed that 100 of the ſingle threads of a full grown ſpider are not equal to the diameter of the hair of his beard; and conſequently, if the threads and hair be both round, ten thouſand ſuch threads are not bigger than ſuch a hair. He calculates further, that when young ſpiders firſt begin to ſpin, four hundred of them are not larger than one which is of a full growth; allowing which, four millions of a young ſpider's

Aranea. der's threads are not so big as the single hair of a man's beard.

Garden-spiders, particularly the short-legged species, yield a kind of silk, which has by some been judged scarce inferior to that of the silk-worm. Mr Bon of Languedoc, about 70 years ago, contrived to manufacture from it a pair of silk stockings and mittens, of a beautiful natural grey colour, which were almost as handsome and strong as those made with common silk: And he published a dissertation concerning the discovery. But M. Reaumur, being appointed by the Royal Academy to make a farther enquiry into this new silk-work, raised several objections and difficulties against it, which are found in the Memoirs of the Academy for the year 1710. The sum of what he has urged amounts to this. The natural fierceness of the spiders renders them unfit to be bred and be kept together. Four or five thousand being distributed into cells, fifty in some, one or two hundred in others, the big ones soon killed and eat the less, so that in a short time there were scarce left one or two in each cell; and to this inclination of mutually eating one another M. Reaumur ascribes the scarcity of spiders, considering the vast number of eggs they lay.

But this is not all: he even affirms that the spider's bag is inferior to that of the silk-worm both in lustre and strength, and that it produces less matter to be manufactured. The thread of the spider's web, he says, only bears a weight of two grains without breaking; and that of the bag bears thirty-six. The latter, therefore, in all probability, is eighteen times thicker than the former; yet it is weaker than that of the silk-worm, which bears a weight of two drams and a half. So that five threads of the spider's bag must be put together to equal one thread of the silk-worm's bag. Now it is impossible these should be applied so justly over one another as not to leave little vacant spaces between them, whence the light will not be reflected; and, of consequence, a thread thus compounded must fall short of the lustre of a solid thread. Add to this, that the spider's thread cannot be wound off as that of the silk worm may, but must of necessity be carded; by which means, being torn in pieces, its evenness, which contributes much to its lustre, is destroyed. In effect, this want of lustre was taken notice of by M. de la Hire, when the stockings were presented to the academy. Again, spiders furnish much less silk than the worms: the largest bags of these latter weigh four grains, the smaller three grains; so that 2304 worms produce a pound of silk. The spider-bags do not weigh above one grain; yet when cleared of their dust and filth, they lose two-thirds of their weight. The work of twelve spiders, therefore, only equals that of one silk-worm; and a pound of silk will require at least 27,648 spiders. But as the bags are wholly the work of the females, who spin them to deposit their eggs in, there must be kept 55,296 spiders to yield a pound of silk. Yet will this only hold of the best spiders; those large ones ordinarily seen in gardens, &c. scarce yielding a twelfth part of the silk of the others. Two hundred and eighty of these, he shows would not yield more than one silk-worm; 663,552 of them would scarce yield a pound.

The act of generation among spiders varies in different species. As these insects prey upon each other, except during the time of their amours, they dare not come within reach of one another but with the utmost caution. They may sometimes be seen stretching out their legs, shaking the webs, and tampering with each other by a slight touch with the extremity of their feet; then, in a fright, dropping hastily down their thread, and returning in a few moments to make fresh trial by feeling. When once both parties are well assured of the sex they have to deal with, the approaches of their feet, in order to feel, become more frequent, confidence takes place, and the instant of amorous dalliance ensues. "We cannot," says Lyonnet, "but admire how careful they are not to give themselves up blindly to a passion, or venture on an imprudent step, which might become fatal to them." A caveat this to the human kind. Lister and Lyonnet, two accurate observers, say, that the extremity of those arms, or claws, which the spider uses to grasp his prey with, suddenly opens, as it were by a spring, and lets out a white body, which the male applies beneath the abdomen of the female to fulfil the wish of nature. In the water-spider, the sexual organs are situated at the hinder parts of the male, are curve, and act as it were by a spring; those of the females are distinct. Nature by a thousand varied methods accomplishes her purpose.

Spiders frequently change their colour, which varies much, in respect to season, sex, age, &c. but they are in general more beautifully variegated in autumn, a season not only the most opportune and plentiful repecting their prey, but the time when they arrive at their greatest magnitude, and are in their height of vigour.

The species of aranea enumerated by naturalists amount to upwards of 50; of which it may here suffice to mention a few of the most remarkable.

1. The calycina, with a round pale yellow belly, and two hollow points. It lives in the cups of flowers, af- the flower-leaves have fallen off; and catches bees, and other flies, when they are in search of honey.

2. The avicularia, has a convex round breast, hollowed transversely in the middle. It is a native of America, and feeds upon small birds, insects, &c. The bite of this spider is as venomous as that of the serpent.

3. The ocellata, has three pair of eyes on its thighs. It is about the same size with the tarantula, of a pale colour, with a black ring round the belly, and two large black spots on the sides of the breast. It is a native of China.

4. The Saccata, has an oval belly, of a dusky iron colour. It lives in the ground, and carries a sack with its eggs where-ever it goes. This sack it glues to its belly, and will rather die than leave it behind.

5. Diadema is the largest spider which this country produces. The abdomen is of and oval form, downy, and of a ruddy yellow colour, which is very variable in different seasons; being sometimes paler, at others very dark coloured. The upper part is beautifully adorned with black and white circles and dots, having a longitudinal band in the middle, composed of oblong and oval-shaped pearl-coloured spots, so arranged as to resemble a fillet, similar to those worn by the eastern kings. The ground upon which this fillet, and the white dots are laid, when viewed with a glass, and the sun shining thereon, is beautiful and rich beyond all description. There are varieties in colour of this spider

Aranea.

der when young: some have their abdomen purple, ornamented with white dots, the legs yellow and annulated with a deeper colour: others have their abdomen of a fine red likewise ornamented with white, but the legs of a fine pale green colour: annulated with dark purple or black. It inhabits the birch-tree.

6. The cucurbitina, has a globular yellow belly, with a few black spots. It lives in the leaves of trees, and incloses its eggs in a soft net.

7. The labyrinthica, with a dusky oval belly, a whitish indented line, and a forked anus. The web of this species is horizontal, with a cylindrical well or tube in the middle.

8. The fimbriata, has a black oblong belly, with a white line on each side, and dusky-coloured legs. It lives in water, upon the surface of which it runs with great swiftness.

9. The holosericea, has an ovalish belly covered with a down-like velvet; at the base, or under part, it has two yellow spots. It is found in the folded leaves of plants.

10. The viatica, or wanderer, is generally of a yellow colour more or less deep. Sometimes it is whitish and even rather green. The abdomen is large, broad, almost square, with two bands of dark orange, which arising from the thorax descend obliquely on the sides towards the middle. Between the bands are a few small black dots forming a kind of triangle upon the middle of the abdomen. On the thorax are seen two longitudinal bands somewhat green, one on each side. The two foremost pair of legs are very long, and the hinder short; which makes it walk like a crab. It is found upon plants; and is a lively, active, indefatigable hunter. Without any motion of the head, which is furnished with immovable eyes, it perceives all the flies that hover round about, does not scare them, but stretches over them its arms furnished with feathers, which prove nets in which their wings intangle. It is said to sit on its eggs; which however it often carries about with it, wrapt up in a ball of white silk.

11. The aquatica, is of a livid colour, with an oval belly, and a transverse line, and two hollowed points. It frequents the fresh waters of Europe. But it is in some sort amphibious: for it can live on land as well as in the water, and comes often on shore for its food; yet it swims well in water, both on its belly and back; it is distinguishable by its brightness. In the water its belly appears covered with a silver varnish, which is only a bubble of air attached to the abdomen by means of the oily humours which transpire from its body, and prevent the immediate contact of the water. This bubble of air is made the substance of of its dwelling, which it constructs under water; for it fixes several threads of silk, or such fine matter, to the stalks of plants in the water; and then ascending to the surface, thrusts the hinder part of its body above water, drawing it back again with such rapidity, that it attaches underneath a bubble of air, which it has the art of detaining under water, by placing it underneath the threads abovementioned, and which it binds like a covering almost all around the air-bubble. Then it ascends again for another air-bubble; and thus proceeds until it has constructed a large aerial apartment under water, which it enters into or quits at pleasure. The male constructs for himself one near to the female; and when love invites, he breaks through the thread walls of the female's dwelling, and the two bubbles attached to the bellies of both unite into one, forming one large nuptial chamber. The female is sometimes laid for a whole day together stretched on her back, waiting for the arrival of the male, without motion, and seemingly as if dead. As soon as he enters and glides over her, she seems to be brought to life again, gets on her legs and runs after the male, who makes his escape with all possible speed. The female takes care of the young, and constructs similar apartments on purpose for them. The figure of this spider has nothing remarkable; and would be overlooked among a croud of curiosities, if the spectator be unacquainted with its singular art of constructing an aerial habitation under water, and thus uniting together the properties of both elements. It lodges during the winter in empty shells, which it dexterously shuts up with a web.

12. The fasciata, with yellow bands round the belly, and dusky rings on the legs, is a native of Barbary, and is as large as the thumb. It inhabits hedges and thickets: its webs have large meshes, and it resides in the centre. The snares are spread for large flies, wasps, drones, and even locusts: the lesser insects can escape through the meshes. The animal which it entangles is soon bound with strong threads; killed by the spider's jaws; and partly eat, if the spider is hungry: the rest is concealed under some neighbouring dry leaves, covered with a kind of web and a blackish glue in great abundance. Its larder is said to be often plentifully stored: —Its nest is of the size of a pigeon's egg, divided horizontally, and suspended by the threads of the insect, which are of a silvery white, and stronger than silk. The young ones live in amity; but when grown up, are mortal enemies. They never meet but they fight with violence, and their battle only ends with the death of the weakest. The dead body is carefully stored in the larder. Twelve of these spiders, by way of experiment, were shut up together; and, after a battle of eight days, the strongest only remained alive.

13. The tarantula, has the breast and belly of an ash-colour; the legs are likewise ash-coloured, with black- Plate XVII. ish rings on the under part; the fangs or nippers are (in Vol. I.) red on the inner side, the rest being blackish: Two of its eyes are larger than the other, red, and placed in the front; four other eyes are placed in a transverse direction towards the mouth; the other two are nearer the back: It has two antennæ or feelers. It is a native of Italy, Cyprus, Barbary, and the East Indies. It lives in bare fields, where the lands are fallow, but not very hard, and from its antipathy to damp and shade, chooses for its residence the rising part of the ground facing the east Its dwelling is about four inches deep, and half an inch wide; at the bottom it is curved, and there the insect sits in wet weather, and cuts its way out if water gains upon it. It weaves a net at the mouth of the hole. These spiders do not live quite a year. In July they shed their skin, and proceed to propagation; which, from a mutual distrust, as they frequently devour one another, is a work undertaken with great circumspection. They lay about seven hundred and thirty eggs, which hatch in the spring; but the parent does not live to see her progeny, having expired early in the winter. The Ichneumon fly is their most formidable enemy.

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The bite of the tarantula is said to occasion an inflammation in the part, which in a few hours brings on sickness, difficulty of breathing, and universal faintness. The person afterwards is affected with a delirium, and sometimes is seized with a deep melancholy. The same symptoms return annually, in some cases for several years; and at last terminate in death. Music, it has been pretended, is the only cure. A musician is brought, who tries a variety of airs, till at last he hits upon one that urges him to dance; the violence of which exercise produces a proportionable agitation of the vital spirits, attended with a consequent degree of perspiration, the certain consequence of which is a cure. Such are the circumstances that have been generally related, and long credited, concerning the bite of this animal. Kircherus, in his *Musurgia*, gives a very particular account of the symptoms and cure, illustrated by histories of cases. Among these, he mentions a girl, who, being bitten by this insect, could be cured only by the music of a drum. He then proceeds to relate, that a certain Spaniard, trusting to the efficacy of music in the cure of the frenzy occasioned by the bite of the tarantula, submitted to be bitten on the hand by two of these creatures, of different colours, and possessed of different qualities. The venom was no sooner diffused about his body, than the symptoms of the disorder began to appear; upon which harpers, pipers, and other musicians, were sent for, who by various kinds of music endeavoured to rouse him from that stupor into which he was fallen: but here it was observed that the bites of the two insects had produced contrary effects; for by one he was incited to dance, and by the other he was restrained therefrom; and in this conflict of nature the patient expired. The same account is given in his *Phonurgia Nova*, with the addition of a cut respresenting the insect in two positions, the patient in the action of dancing, together with the musical notes of the tune or air by which in one instance the cure was affected.

In his *Musurgia*, this author, attempting mechanically to account for the cure of the bite of the tarantula by music, says of the poison, That it is sharp, gnawing and bilious; and that it is received and incorporated into the medullary substance of the fibres. With respect to the music, he says, That the sounds of chords have a power to rarefy the air to a certain harmonical pitch; and that the air thus rarefied, penetrating the pores of the patient's body, affects the muscles, arteries, and minute fibres, and incites him to dance; which exercise begets a perspiration, in which the poison evaporates.

Unsatisfactory as this theory appears, the belief of this strange phenomenon has prevailed among the ablest of modern physicians. Sir Thomas Brown, so far from disputing it, says, That since many attest the fact from experience, and that the learned Kircherus hath positively averred it, and set down the songs and tunes solemnly used for the cure of the disease, and since some also affirm that the tarantula itself will dance at the sound of music, he shall not at all question it*.

* *Inquiries into Vulgar Errors*, B. iii. c. 28.

Farther, that eminent Italian physician of the last century, Baglivi, a native of Apulia, the country where the tarantula is produced, has written a dissertation *De anatomia, morsu, et effectibus tarantulæ*. In this he describes the region of Apulia where the tarantula is produced, with the anatomy and figure of the insect and its eggs, illustrated by an engraving; he mentions particularly the symptoms that follow from the bite, and the cure of the disease by music, with a variety of histories of cures thus wrought, many of them communicated by persons who were eye-witnesses of the process.

Ludovicus Valetta, a Celestine monk of Apulia, published at Naples, in the year 1706, a treatise upon this spider, in which he not only answers the objections of those who deny the whole thing, but gives, from his own knowledge, several instances of persons who had suffered this way, some of whom were of great families, and so far from being dissemblers, that they would at any rate, to avoid shame, have concealed the misfortune which had befallen them.

The honourable Mr Robert Boyle, in his treatise of Languid and Unheeded Motions, speaking of the bite of the tarantula, and the cure of the disease which follows it by means of music, says, That, having himself had some doubts about the matter, he was, after strict inquiry, convinced that the relations in the main were true.

Lastly, Dr Mead, in his Mechanical Account of Poisons, has given an essay on the tarantula, containing the substance of the above relations, which he endeavours to confirm by his own reasoning thereon.

Notwithstanding the number and weight of these authorities, and the general acquiescence of learned and ingenious men in the opinion that the bite of the tarantula is poisonous, and that the cure of the disorder occasioned by it is effected by music, we have reason to apprehend that the whole is a mistake.

In the Philosophical Transactions for the year 1672, p. 406, is an extract of a letter from Dr Thomas Cornelio, a Neapolitan physician, to John Doddington, Esq; his majesty's resident at Venice, communicated by the latter, in which, speaking of his intention to send to Mr Doddington some tarantulas, he says, "Mean while I shall not omit to impart to you what was related to me a few days since by a judicious and unprejudicate person; which is, that being in the country of Otranto, where those insects are in great numbers, there was a man, who, thinking himself stung by a tarantula, showed in his neck a small speck, about which in a very short time there arose some pimples full of a serous humour; and that in a few hours after, the poor man was sorely afflicted with very violent symptoms, as syncopes, very great agitations, giddiness of the head, and vomiting; but that, without any inclination at all to dance, and without a desire of having any musical instruments, he miserably died within two days. The same person affirmed to me, that all those that think themselves bitten by tarantulas, except such as for evil ends feign themselves to be so, are for the most part young wanton girls, whom the Italian writers call *Dolce di Sale*; who, by some particular indisposition falling into this melancholy madness, persuade themselves, according to the vulgar prejudice, to have been stung by a tarantula."

Dr Serao, an Italian physician, has written an ingenious book, in which he has effectually exploded this opinion as a popular error; and in the Philosophical Transactions, N° LX. for the year 1770, p. 236, is a letter from Dominico Cirillo, M. D. professor

feſſor of natural hiſtory in the univerſity of Naples, wherein, taking notice of Serao's book, he ſays, That having had an opportunity of examining the effects of this animal in the provine of Taranto, where it is found in great abundance, he finds that the ſurpriſing cure of the bite of the tarantula by muſic has not the leaſt truth in it; and that it is only an invention of the people, who want to get a little money by dancing when they ſay the tarantiſm begins. He adds, "I make no doubt but ſometimes the heat of the climate contributes very much to warm their imaginations, and throw them into a delirium, which may be in ſome meaſure cured by muſic; but ſeveral experiments have been tried with the tarantula, and neither men nor animals after the bite have had any other complaint than a very trifling inflammation upon the part, like that produced by the bite of a ſcorpion, which goes off by itſelf without any danger at all. In Sicily, where the ſummer is ſtill warmer than in any part of the kingdom of Naples, the tarantula is never dangerous; and muſic is never employed for the cure of the pretended tarantiſm."

Mr Swinburn, when in the country of the tarantula, was deſirous of inveſtigating minutely every particular relative to that inſect; but the ſeaſon was not far enough advanced, and no *tarantati* (perſons bitten, or pretending to be bitten, by the tarantula) had begun to ſtir. He prevailed, however, upon a woman who had formerly been bitten, to act the part, and dance the tarantata before him. A great many muſicians were ſummoned, and ſhe performed the dance, as all preſent aſſured him, to perfection. At firſt ſhe lolled ſtupidly on a chair, while the inſtruments were playing ſome dull muſic. They touched, at length, the chord ſuppoſed to vibrate to her heart; and up ſhe ſprang with a moſt hideous yell, ſtaggered about the room like a drunken perſon, holding a handkerchief in both hands, raiſing them alternately, and moving in very true time. As the muſic grew briſker, her motions quickened, and ſhe ſkipped about with great vigour and variety of ſteps, every now and then ſhrieking very loud. The ſcene was far from pleaſant; and, at his deſire, an end was put to it before the woman was tired. Wherever the tarantati are to dance, he informs us, a place is prepared for them, hung round with bunches of grapes and ribbons. The patients are dreſſed in white, with red, green, or yellow ribbons, for thoſe are their favourite colours; on their ſhoulders they caſt a white ſcarf, let their hair fall looſe about their ears, and throw their heads as far back as they can bear it. They are exact copies of the ancient prieſteſſes of Bacchus. The orgies of that god, whoſe worſhip, under various ſymbols, was more widely ſpread over the globe than that of any other divinity, were no doubt performed with energy and ethuſiaſm by the lively inhabitants of this warm climate. The introduction of Chriſtianity aboliſhed all public exhibitions of theſe heatheniſh rites, and the women durſt no longer act a frantic part in the character of Bacchantes. Unwilling to give up ſo darling an amuſement, they deviſed other pretences; and poſſeſſion by evil ſpirits may have furniſh them with one. Accident may alſo have led them to a diſcovery of the tarantula; and, upon the ſtrength of its poiſon, the Puglian dames ſtill enjoy their old dance, though time has effaced the memory of its ancient name and inſtitution: and this Mr Swinburn takes to be the origin of ſo ſtrange a practice. If at any time theſe dances are really and involuntarily affected, he ſuppoſes it can be nothing more than an attack upon their nerves, a ſpecies of St Vitus's dance: and he inclines the more to the idea, as there are numberleſs churches and places throughout theſe provinces dedicated to that ſaint.

Many ſenſible people of the country, however, differ in opinion from Dr Serao and other authors, who have ridiculed the pretended diſorder, and affirmed that the venom of this ſpecies of ſpider can produce no effects but ſuch as are common to all others. The Brindiſians ſay, that the tarantulas ſent to Naples for the experiment were not of the true ſort, but a much larger and more innocent one; and that the length of the journey, and want of food, had weakened their power ſo much, as to ſuffer the Doctor or others to put their arm into the bag where they were kept with impunity. They quote many examples of perſons bitten as they ſlept out in the fields during the hot months, who grew languid, ſtupid, deprived of all courage and elaſticity, till the ſound of ſome favourite tune rouſed them to dance, and throw off the poiſon. Theſe arguments of theirs, however, Mr Swinburn thinks of little weight: for they acknowledged that elderly perſons were more frequently infected than young ones; and that moſt of them were women, and thoſe unmarried. No perſon above the loweſt rank in life was ever ſeized with this malady, nor is there an inſtance of its cauſing death. The length of the dance, and the patient's powers of bearing ſuch exceſſive fatigue in the canicular ſeaſon, prove nothing; becauſe every day, at that time of the year, peaſants may be ſeen dancing with equal ſpirit and perſeverance, though they do not pretend to be ſeized with the tarantiſm. The illneſs may therefore be attributed to hyſterics, exceſſive heat, ſtoppage of perſpiration, and other effects of ſleeping out of doors in a hot ſummer air, which is always extremely dangerous, if not mortal, in moſt parts of Italy. Violent exerciſe may have been found to be a certain cure for this diſorder, and continued by tradition, though the date and circumſtances of this diſcovery have been long buried in oblivion; a natural paſſion for dancing, imitation, cuſtom of the country, and a deſire of raiſing contributions upon the ſpectators, are probably the real motives that inſpire the tarantati. Before Serao's experiments, the tarantula had been proved to be harmleſs, from trials made in 1693 by Clarizio, and in 1740 at Lucera by other naturaliſts.

ARANJUEZ, a town in the province of New Caſtile, where the king of Spain has a palace and gardens which are reckoned the moſt delightful in the world.

This place is 20 miles from Madrid, by a noble road, planted on each ſide with trees, lately made at the expence of 120,000l. Sterling. It is delightfully ſituated at the conflux of the rivers Tagus and Jarama; which run through the gardens, and add new beauty to this charming ſpot, where art and nature ſeem to go hand in hand with the moſt pleaſing and rural ſimplicity. On one ſide, fine avenues of ſtately oaks and lofty elms convey the trueſt ideas of magnificence, while they afford the moſt reviving ſhade; on the other, the ſudden tranſitions to lawns and wilderneſs, Aranjuez. nefs, the cafcades of water breaking through the thickets, the tuneful fongs of numberlefs birds fheltered in thefe cool receffes, the occafional appearance and paffage of the monarch attended by the grandees of his kingdom; all thefe objects united, and concentered in one point, fill the imagination with pleafing ideas, and imprefs the mind of a traveller with a thoufand agreeable fenfations.

The general fituation is in a very large plain furrounded with large hills, of a moft difagreeable afpect indeed, but feldom appearing, being well hidden by the noble rows of trees that extend acrofs the flat in every direction. The main body of the palace is an old building, to which have been lately added two new wings. The firft part of the building was erected by Philip II. who purchafed the eftate, planted many of the avenues, and, in order to extend his chafe, or to indulge his fplenetic difpofition, had all the vines that grew on the hills rooted up. By that means he drove away the inhabitants, and rendered the environs of his villa a perfect defart.—The apartments are good; but contain nothing very particular to take off from the enjoyment of fo many fine objects abroad. In one of the new wings is a play-houfe, and in the other a chapel. Part of the ceiling of the former was painted by Mengs, who was alfo fent to Rome to paint a holy family for the principal altar in the chapel. There are feven fine pictures of Luca Jordano in the apartment called El Cabinete Antiguo, and fix others in that De los Mayordomos. The portraits of the grand duke and duchefs of Tufcany, by Mengs, are in a new apartment called the *king's dreffing-room*. In the chapel, over the great altar, there is a fine picture of the Annunciation, by Titian, prefented to him by Charles V. and brought from the convent of Jufte, after the death of that emperor. The porcelain cabinet, where there are feveral large pieces of the king's own manufactory, is alfo an object of curiofity to a traveller.

As to the gardens, the whole of them may be thrown into three grand divifions, diftinguifhed by the names of La Huerta Valenciana, Los Deleites, and El Cortijo. In the Huerta Valenciana, agriculture and gardening are carried on in the fame manner as in that fruitful province, and they plough with horfes. In the Cortijo they ufe oxen, as in Andalufia; and in other places they fcratch up the ground with mules, as is ftill practifed in fome parts of Spain. Which ever way one looks round, a conftant variety pleafes the eye, and enraptures the mind. At one moment the fturdy buffalo moves before you, drawing his heavy burden; foon after, the flow camel, with his ponderous load; while the fwift zebra with his ftriped garment frifks over the plains. If you approach the farm, every object of convenience is confulted, and in the dairy every degree of neatnefs. The Dutch cow enjoys a luxuriant pafture, the brood mares greatly enliven the landfcape, and ftables are filled with the moft excellent horfes. And an immenfe nurfery furnifhes all manner of trees and plants. The fine avenue, which ferves alfo for a public walk, called Calle de Reyna, has nothing equal to it at Verfailles. It is three miles long, quite ftraight from the palace gate, croffing the Tagus twice before it lofes itfelf in the thickets, where fome noble fpreading elms and weeping poplars hang beautifully over the deep ftill pool. Near this road is a flower-garden for the fpring, laid out with great tafte by Mr Wall during his miniftry. The gay variety of flowers at this time of year is particularly pleafing to the eye; but its beauty foon fades on the approach of fummer. As the weather grows hot, the company that choofes to walk retires to a garden in an ifland of the Tagus, on the north fide of the palace. This is an heavenly place, cut into various walks and circular lawns, which in their primitive ftate may have been very ftiff and formal: but in the courfe of a century, Nature has obliterated the regular forms of art; the trees have fwelled out beyond the line traced for them, and deftroyed the enfilade by advancing into the walls or retiring from them. The fweet flowering-fhrubs, inftead of being clipped and kept down, have been allowed to fhoot up into trees, and hang over the ftatues and fountains they were originally meant to ferve as humble fences to. The jets-d'eau dafh up among the trees, and add frefh verdure to the leaves. The terraces and baluftrades built along the river, are now overgrown with rofes, and other luxuriant bufhes, hanging down into the ftream, which is darkened by the large trees growing on the oppofite banks. Many of the ftatues, groupes, and fountains, are handfome, fome mafterly, the works of Algardi: all are placed in charming points of view, either in open circular fpots, at a diftance from the trees, or elfe in gloomy arbours, and retired angles of the wood. The banks of this wood, called the Ila, are alfo enlivened by elegant yachts for the amufement of the royal family.

Aranjuez, Arar.

The town or village formerly confifted of the palace, its offices, and a few miferable huts, where the ambaffadors, and the attendants of the court, endeavoured to lodge themfelves as well as they could, but always very uncomfortable; many of the habitations were vaults half under ground. What determined the king to build a new town, and to embellifh the environs, was an accident that happened at the nuncio's; a coach broke through the cieling of his dining-room, and fell in upon the table. The court then began to apply very confiderable fums to the purpofe of errecting proper dwellings for the great number of perfons that flock to the place where the fovereign refides; near 10,000 are fuppofed to live here two or three months in fpring; the king keeps 115 fets of mules, which require a legion of men to to take care of them. Above a million Sterling has been laid out at Aranjuez fince the year 1763; and it muft be acknowledged, that wonders have been performed: feveral fine ftreets drawn in ftraight lines with broad pavements, a double row of trees before the houfes, and a very noble road in the middle; commodious hotels for the minifters and ambaffadors; great fquares, markets, churches, a theatre, and an amphitheatre for bull-feafts, have been raifed from the ground; befides the acceffion of two new wings to the palace. Neatnefs and convenience have been more ftudied and fought for than fhow in the architecture, but altogether the place has fomething truly magnificent in the coup d'œil.

ARAR, (Cæfar, Strabo); *Araris*, (Dio Caffius); *Saucona*, (Ammian): A river of Celtic Gaul, now the *Saone*; which rifes out of mount Vogefus on the confines of Lorrain, runs through the Franche Comte and Burgundy, and below Lyons falls into the Rhone. It is fo incredibly flow, that the eye cannot diftinguifh which

which way it moves, (Cæſar); and therefore Pliny calls it the *Sluggiſh river*. Its courſe is from north to ſouth. It is famous for a bridge of Cæſar, which was built by the ſoldiers in one day. It is navigable equally with the Rhone.

ARARAT, the name of the mountain on which Noah's ark reſted, after the abatement of the waters of the univerſal deluge. Concerning this mountain there are various conjectures; though it is almoſt univerſally allowed to be in Armenia Major. Some are of opinion that it is one of the mountains which divide Armenia on the ſouth from Meſopotamia and that part of Aſſyria inhabited by the *Curds;* from whom theſe mountains took the name of *Curdu* or *Cardu*; by the Greeks turned into *Gordyæi*, &c. Others, that it lies towards the middle of Armenia, near the river Araxes, above 280 miles diſtant from the abovementioned mountains, making it belong to mount Taurus; but the Armenians are poſitive that Noah's Ararat is no other than a mountain to which they now give the name of *Maſis*, which lies about 12 leagues to the eaſt of Erivan, and four leagues from the Aras. It is encompaſſed by ſeveral petty hills: on the tops of them are found many ruins, thought to have been the buildings of the firſt men, who were, for ſome time, afraid to deſcend into the plains. It ſtands by itſelf, in form of a ſugar-loaf, in the midſt of a very large plain, detached, as it were, from the other mountains of Armenia, which make a long chain. It conſiſts, properly ſpeaking, of two hills; the leſſer of which is the more ſharp and pointed: the higher, on which it is ſaid the ark reſted, lies to the north-weſt of it, and riſes far above the neighbouring mountains. It ſeems ſo high and big, that, when the air is clear, it may be ſeen four or five days journey off; yet travellers think the height is not extraordinary. Chardin is of opinion that he paſſed a part of mount Caucaſus which is higher; and Poullet thinks the height of mount Maſis, or Ararat, not above twice as great as that of mount Valerian near Paris. They therefore think that its being viſible at ſuch a great diſtance is owing to its lonely ſituation in a vaſt plain, and upon the moſt elevated part of the country, without any mountains before it to obſtruct the view. Nor is the ſnow with which it is always covered from the middle upwards any argument of its height; for, in this country, ice hath often been obſerved in the mornings of the middle of July. (See ARMENIA). Certain it is, however, that this mountain hath never yet been aſcended; which the Armenians pretend was owing to the interpoſition of angels, in order to diſappoint the curioſity of thoſe who wanted to advance to ſuch a ſacred place as that whereon the ark reſted: but the exceſs of cold may very reaſonably be ſuppoſed able to fruſtrate all ſuch attempts, without any ſupernatural interpoſition. The moſt diſtinct account we have of this mountain is that given by Mr Tournefort; which, however, being much ſwelled with immaterial circumſtances, it is needleſs to trouble our readers with at length. He tells us, that this mountain is one of the moſt diſagreeable ſights upon earth, without either houſes, convents, trees, or ſhrubs; and ſeems as if continually waſting and mouldering away. He divides it into three regions: The lowermoſt, he ſays, is the only one which contains any human creatures, and is occupied by a few miſerable ſhepherds that tend ſcabby flocks; and here are alſo found ſome partridges; the ſecond is inhabited by crows and tigers; and all the reſt is covered with ſnow, which half the year is involved in thick clouds. On the ſide of the mountain that looks towards Erivan is a prodigious precipice, from whence rocks of an immenſe ſize are continually tumbling down with a hideous noiſe. This precipice ſeems quite perpendicular; and the extremities are rough and blackiſh, as if ſmutted with ſmoke. The ſoil of the mountain is looſe, and on the ſandy parts it is impoſſible to take a firm ſtep; ſo that our traveller encountered great difficulties in his aſcent and deſcent of this mountain; being often obliged, in order to avoid the ſand, to betake himſelf to places where great rocks were heaped on one another, under which he paſſed as through caverns, or to places full of ſtones, where he was forced to leap from one ſtone to another. If we may believe Struys, a Dutch writer, however, all theſe difficulties may be ſurmounted. He aſſures us, he went five days journey up mount Ararat, to ſee a Romiſh hermit: that he paſſed through three regions of clouds; the firſt dark and thick, the next cold and full of ſnow, and the third colder ſtill: that he advanced five miles every day; and when he came to the place where the hermit had his cell, he breathed a very ſerene and temperate air: that the hermit told him, he had perceived neither wind nor rain all the 25 years he had dwelt there; and that on the top of the mountain there ſtill reigned a greater tranquility, whereby the ark was preſerved uncorrupted. He farther pretends, that the hermit gave him a croſs made out of the wood of the ark, together with a certificate; a formal copy of which the author has given in his ſham relation.

ARASSI, a maritime, populous, and trading town of Italy, in the territory of Genoa. E. Long. 7. 20. N. Lat. 44. 3.

ARATEIA, in antiquity, a yearly feſtival celebrated at Sicyon, on the birth-day of Aratus, wherein divers honours were paid by a prieſt conſecrated to this ſervice, who for diſtinction's ſake wore a ribband beſpangled with white and purple ſpots. The arateia were ſolemnized with much pomp of muſic, the choiriſters of Bacchus attending.

ARATUS, general of the Achæans, conquered Niocles tyrant of Sicyon. Two years after, he ſurpriſed the caſtle called *Acrocorinthus*, and drove out the king of Macedonia: he delivered Argos from its tyrants, and was poiſoned by Philip II. king of Macedonia, whom he had newly reſtored: he was about 62 when he died, the ſecond year of the 141ſt Olympiad. He was intered at Sicyon, and received the greateſt honours from his countrymen. His ſon, who had alſo been prætor, was poiſoned by king Philip. Polybius gives us ſo great a character of Aratus the father's Commentaries or Hiſtory, that the loſs of ſo valuable a work is highly to be regretted.

ARATUS, a Greek poet, born at Soli, or Solæ, a town in Cilicia, which afterwards changed its name, and was called *Pompeiopolis*, in honour Pompey the Great. He flouriſhed about the 124th, or, according to ſome, the 126th Olympiad, in the reign of Ptolemy Philadelphus king of Egypt. He diſcovered in his youth a remarkable poignancy of wit, and capacity for improvement; and having received his education

under

under Dionysius Heracleotes, a Stoic philosopher, he espoused the principles of that sect. Aratus was physician to Antigonus Gonatus, the son of Demetrius Poliorcetes, king of Macedon: this prince, being a great encourager of learned men, sent for him to court, admitted him to his intimacy, and encouraged him in his studies. The *phænomena* of Aratus, which is still extant, gives him a title to the character of an astronomer as well as a poet; in this piece he describes the nature and motion of the stars, and shows the particular influences of the heavenly bodies, with their various dispositions and relations. He wrote this poem in Greek verse: it was translated into Latin by Cicero; who tells us in his first book, *De oratore*, that the verses of Aratus are very noble. This piece was translated by others as well as Cicero; there being a translation by Germanicus Cæsar, and another into elegant verse by Festus Avienus. An edition of the *phænomena* was published by Grotius, at Leyden, in quarto, 1600, in Greek and Latin, with the fragments of Cicero's version, and the translation of Germanicus and Avienus, all which the editor has illustrated with curious notes. He was certainly much esteemed by the ancients, since we find so great a number of scholiasts and commentators upon him. There are several other works also ascribed to Aratus. Suidas mentions the following: Hymns to Pan; Astrology and Astrothesy; a composition of antidotes; an Επιθυτικον on Theopropus; an Ηθοποιια on Antigonus; an epigram on Phila, the daughter of Antipater, and wife of Antigonus; an Epicedium of Cleombrotus; a correction of the Odyssey; and some Epistles, in prose. Virgil, in his Georgics, has imitated or translated many passages from this author; and St. Paul has quoted a passage of Aratus. It is in his speech to the Athenians (Acts xvii. 28.) wherein he tells them, that some of their own poets have said, Τȣ γὰρ καὶ γένος ἐσμεν: "For we are also his offspring." These words are the beginning of the fifth line of the *phænomena* of Aratus.

ARAVA, a fortress of Upper Hungary, in a county and on a river of the same name. E. Long. 20. 0. N. Lat. 49. 20.

ARAUCO, a fortress and town of Chili, in South America; situated in a fine valley, on a river of the same name. The natives are so brave, that they drove the Spaniards out of their country, though they had no fire arms. W. Long. 71. 20. S. Lat. 42. 30.

ARAUSIO, or *Civitas Arausiensis*, or *Arausicorum* (Notitiæ); *Colonia Secundanorum* (Mela, Pliny, Coins); so called because the veterans of the second legion were there settled: The capital of the Cavares, in Gallia Narbonensis. Now *Orange*, in the west of Provence, on an arm of the river Egue, which soon after falls into the Rhone, from which it is distant a league to the east, at the foot of a mountain. Here is an ancient amphitheatre to be still seen. E. Long. 4. 46. Lat. 44. 10.

ARAW, a town of Swisserland, in Argow, seated on the river Aar. It is handsome, large, and remarkable for its church, its fountain, and the fertility of the soil. E. long. 18. 0. N. Lat. 47. 25.

ARAXES, now the ARAS, a river of Armenia Major, which takes its rise in a mountain called *Albos*, where the Euphrates also hath its origin. From this mountain it runs eastward with a serpentine course, discharging itself into the Caspian sea, after a run of upwards of 500 miles, during which it receives some considerable rivers. Some have imagined that it hath its rise in mount Ararat; but Tournefort assures us that it comes no nearer that mountain than 12 miles. The Araxes is a very rapid river, and is supposed to be the Gihon mentioned by Moses. Besides this extreme rapidity, it is very apt to overflow after rains; so that they have in vain endeavoured to build bridges over it; tho' some of them appear, from the few arches remaining, to have been built of the best materials, and in the strongest manner. Such is the vehemence of its current after the thawing of the adjacent snows, or some fierce rains, that neither banks nor dykes can resist it; so that nothing can be more terrible than the noise and violence of its waves at such times: but in winter, when its waters are low, it is fordable in some places on camels.

ARBA (anc. geog.), an island and city of Illyria. Now *Arbe*, in the gulph of Quarnaro. Of this island, which has been but slightly noticed by geographers, we have the following description by the Abbé Fortis.

In the Roman times, it is probable that there were no other cities in Arbe but that which bears the name of the island, in the neighbourhood of which ancient monuments are frequently dug up.

This city of Arbe, though the capital of a small island, not above thirty miles round, wholly uncultivated, and uninhabitable in the highest part that faces the channel of Morlacca, has always maintained itself with decorum. That it was inhabited by civilized people in the Roman times, is evident, by the inscriptions that have been frequently discovered there, and others still remain at Arbe. In the lower times it suffered all the calamities to which the neighbouring countries were subjected, but it always recovered itself with honour even after dissolution.

The archives of the community of Arbe contain some ancient papers that are truly valuable, and they are kept with great jealousy; by them it appears, that, in the eleventh century, gold and silk were not rare among the inhabitants. Arbe was subject to the kings of Hungary; afterwards it became dependent on Venetian feudatories; and at last was taken under the immediate dominion of the most serene republic, by which a governor is appointed who has the title of count and captain. The number of people on the island does not much exceed three thousand souls, distributed in a few parishes, which might be officiated by a small number of priests: yet, through a monstrous inconsistency that falls very heavy on the poor inhabitants, they have to maintain no less than three convents of friars, and as many of nuns, besides the considerable charge of near sixty priests, who have a very scanty provision.

The climate of Arbe is none of the happiest; the winter season is horrid, especially when agitated by the violent northerly winds, which sometimes transform the intermediate seasons into winter, and cause the summer itself to disappear. These furious winds do great damage to the island, particularly in the winter and spring. Two years ago, about twelve thousand sheep perished in one night, of cold, in the common pastures of the mountain; where, according to the cus-

Arba.

tom over all Dalmatia, they are left in the open air the whole year round. The ſalt fog raiſed by the dreadful commotion of the waves, which often roar, between the mountains of Arbe and the oppoſite Alps, in the narrow channel of Morlacca, conſumes all the buds of the plants and corn, if it happens to be driven upon the iſland by the wind; and it is followed by a cruel ſcarcity of every kind of produce. This calamity communicates its baneful influence even to the fleſh of the animals left on the paſtures, that becomes ill-taſted, in conſequence of the bitterneſs and bad nouriſhment of the food. Abſtracting from theſe irregularities, the air of Arbe is healthful; nor ought the conſtant ſummer fevers among the inhabitants to be attributed to its influence as they are, more probably, derived from unwholeſome food, and a way of life differing little from that of the Hottentots.

The appearance of the iſland is exceedingly pleaſant. On the eaſt it has a very high mountain, of the ſame ſubſtance as the Morlacca, of which it was at once a part. At the foot of this mountain, the reſt of the iſland is extended to the weſtward, and divided into beautiful and fruitful plains interſperſed with little hills fit to bear the richeſt products. At the extremity that looks to the north, a delightful promontory, called Loparo, ſtretches into the ſea; it is crowned with little hills, which almoſt quite incloſe a fine cultivated plain. Near this promontory are the two ſmall iſlands of S. Gregorio and Goli, very uſeful to ſhepherds and fiſhers. The coaſt of Arbe, that faces the Morlacca mountains, is quite ſteep and inacceſſible; and the channel between them is extremely dangerous, being expoſed to furious winds, and without a ſingle port on either ſide. The long and narrow iſland of Dolin, lying parallel to the iſland of Arbe, along the coaſt of Barbado, forms a channel leſs dangerous, though by no means ſo ſecure as it is beautiful to look at. There are ſeveral harbours in the neighbourhood of the city of Arbe, by which the trade of the beſt part of the iſland is facilitated.

The city ſtands on a riſing ground between two harbours, which form a peninſula; it contains about a thouſand inhabitants, among whom are many noble families, but few of them are rich. Among the moſt remarkable curioſities of the iſland, the Arbegiani are proud of many egregious reliques, and particularly of the head of S. Criſtofano their protector; but the lovers of ſacred antiquity will find ſomething much more ſingular in the three heads of Shadrach, Meſhech, and Abednego, which are venerated there with great devotion. Four of the principal gentlemen are keepers of the ſanctuary, and to their care the precious records of the city are alſo committed. Among theſe records there is a tranſaction of MXVIII. by which the city of Arbe promiſes to the Doge of Venice, Ottone Orſeolo, a tribute of ſome pounds *de ſeta ſerica*, "of wrought ſilk," and in caſe of contravention, pounds *de auro obrizo* "of pure gold."

In the laſt age there was a learned biſhop of Arbe, named Ottavio Spaderi, who would not permit the reliques of S. Criſtofano to be expoſed to the public veneration, on the ſolemnity of the ſaint's day, becauſe he doubted of their authenticity. The mob roſe, and was going to throw him down from the top of the hill on which the cathedral ſtands; nor did the tumult ceaſe after the day was paſt. The government ſent an armed veſſel to deliver the prelate from the danger he was in; and the pope thought proper to give him a more tractable ſpouſe in Italy.

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The nature of the ſoil of Arbe is not the ſame in every ſituation; nay it would be difficult to find a country where there is ſo great a variety in ſo little ſpace. There is a very great difference between the ground of the extremity of the mountain above the channel of Barbado, and the ſides of it on the one part towards the iſland, and on the other facing the ridge of Morlacca. Nor is the top of the mountain itſelf always of the ſame ſtructure: for in ſome parts it is extended in a fine level plain, partly woody and partly cultivable; in other places it is quite rocky, and compoſed of bare marble. The ground at the foot of the mountain, where it ſtretches towards the ſhore, oppoſite to Jablanaz, is nothing but marble; and, in the diſtrict of Barbado it is gravelly, and a good ſoil for vines. The wine of Barbado is of excellent quality, and in great eſtimation; hardly any other product is cultivated along that coaſt, as the vines ſucceed ſo well, notwithſtanding the negligent culture. Below the pretended ruins of Colento the land bears vines, olives, mulberry, and other fruit-trees, and alſo corn in the loweſt parts. All the lower part of the iſland is compoſed alternatively of little hills and valleys, and of a ſubſtance for the moſt part very different from that of the mountain and its adjacencies. As the organization of the mountain is wholly of marble, ſo that of the hills is generally arenaceous. The wheſtone forms a lage part, and frequently contains *oſtracites* and *lenticulares*; the exterior ſtratum is commonly friable. The valleys, which according to appearances ſhould be full of ſand, are provided with an excellent ſoil, with ſuch a mixture of very minute ſand as is requiſite to keep it light. Springs of freſh water are by nature well diſtributed over the iſland, and maintain a proper humidity when the ſummer is not exceſſively dry; ſo that the dark verdure of the hills covered with wood, the luxuriance of the vines, and freſhneſs of the corn-ground, form a ſpectacle extremely cheerful and agreeable.

The iſland of Arbe would have every thing requiſite for the ſubſiſtence of its ſmall population, if the land was cultivated by a people leſs ſtupid and lazy. It produces, however, fire-wood, of which many cargoes are annually ſent to Venice; corn, oil, excellent wine, brandy, and ſilk, ſince very ancient times; it alſo exports hides, wool, ſheep, hogs, and horſes of a good breed. There is alſo abundance of good ſalt made on the iſland; and the fiſhing of tunny and mackrel, notwithſtanding it is managed in a ſlovenly and aukward manner, makes no inconſiderable article of trade to the Arbegiani, who, like all their neighbours, find their account in ſelling this commodity to ſtrangers rather than to the Venetians. Yet, with all theſe natural products, the iſland is very far from being rich, or even in a tolerable flouriſhing ſtate; becauſe there is much land left uncultivated, and the peaſants are lazy.

ARBACES governed Media under Sardanapalus. Seeing him ſpinning among a company of his women, he ſtirred up his people to revolt, and dethroned Sardanapalus; who thereupon burnt himſelf in his palace. Arbaces being crowned, began the monarchy of the Medes, which laſted 317 years under nine kings, till

Astyages was expelled by Cyrus. Arbaces reigned 22 years, and died A. M. 3206. See MEDIA.

ARBALEST, or CROSS-BOW. See *CROSS-BOW*.

ARBELA, now IRBIL, a city of Assyria, lying in E. Long. 44. 5. N. Lat. 35. 15. It is famous for the last and decisive battle fought in its neighbourhood between Alexander the Great and Darius Codomannus. This battle was fought 331 years before Christ, and the event of it determined the fate of the Persian empire. Arrian relates, that Darius's army consisted of a million of foot and 40,000 horse; according to Diodorus, there were 200,000 horse, and 800,000 foot; Plutarch relates, that the horse and foot together made up a million; and Justin gives us exactly half Diodorus's number. The Macedonian army, according to Arrian, consisted of 40,000 foot and 7000 horse.

Upon receiving notice of the vast strength of the enemy, Alexander expressed neither surprise nor apprehension; but having "commanded a halt, he encamped four days, to give his men rest and refreshment. His camp being fortified by a good intrenchment, he left in it the sick and infirm, together with all the baggage; and on the evening of the fourth day, prepared to march against the enemy with the effective part of his army, which was said to consist of 40,000 infantry and 7000 horse, unincumbered with any thing but their provisions and armour. The march was undertaken at the second watch of the night, that the Macedonians, by joining battle in the morning, might enjoy the important advantage of having an entire day before them, to reap the full fruits of their expected victory. About half way between the hostile camps, some eminences intercepted the view of either army. Having ascended the rising ground, Alexander first beheld the Barbarians, drawn up in battle array, and perhaps more skilfully marshalled than he had reason to apprehend. Their appearance, at least, immediately determined him to change his first resolution. He again commanded a halt, summoned a council of war; and different measures being proposed, acceded to the single opinion of Parmenio, who advised that the foot should remain stationary until a detachment of horse had explored the field of battle, and carefully examined the disposition of the enemy. Alexander, whose conduct was equalled by his courage, and both surpassed by his activity, performed those important duties in person at the head of his light horse and royal cohort. Having returned with unexampled celerity, he again assembled his captains, and encouraged them by a short speech. Their ardour corresponded with his own; and the soldiers, confident of victory, were commanded to take rest and refreshment.

Gillies's Hist. of Greece.

"Meanwhile Darius, perceiving the enemy's approach, kept his men prepared for action. Notwithstanding the great length of the plain, he was obliged to contract his front, and form in two lines, each of which was extremely deep. According to the Persian custom, the king occupied the centre of the first line, surrounded by the princes of the blood and the great officers of his court, and defended by his horse and foot guards, amounting to 15,000 chosen men. These splendid troops, who seemed fitter for parade than battle, were flanked on either side by the Greek mercenaries and other war-like battalions, carefully selected from the whole army. The right wing consisted of the Medes, Parthians, Hyrcanians, and Sacæ; the left was chiefly occupied by the Bactrians, Persians, and Cardusians. The various nations composing this immense host were differently armed, with swords, spears, clubs, and hatchets; while the horse and foot of each division were promiscuously blended, rather from the result of accident than by the direction of design. The armed chariots fronted the first line, whose centre was farther defended by the elephants. Chosen squadrons of Scythian, Bactrian, and Cappadocian cavalry advanced before either wing, prepared to bring on the action, or after it began to attack the enemy in flank and rear. The unexpected approach of Alexander within sight of his tents prevented Darius from fortifying the wide extent of his camp; and, as he dreaded a nocturnal assault from enemies who often veiled their designs in darkness, he commanded his men to remain all night under arms. This unusual measure, the gloomy silence, the long and anxious expectation, together with the fatigue of a restless night, discouraged the whole army, but inspired double terror into those who had witnessed the miserable disasters on the banks of the Granicus and the Issus.

"At day-break Alexander disposed his troops in a manner suggested by the superior numbers and deep order of the enemy. His main body consisted in two heavy-armed phalanxes, each amounting to above 16,000 men. Of these the greater part formed into one line; behind which he placed the heavy-armed men, reinforced by his targeteers, with orders, that when the out-spreading wings of the enemy prepared to attack the flanks and rear of of his first line, the second should immediately wheel to receive them. The cavalry and light infantry were so disposed on the wings, that while one part resisted the shock of the Persians in front, another, by only facing to the right or left, might take them in flank. Skilful archers and darters were posted at proper intervals, as affording the best defence against the armed chariots, which (as Alexander well knew) must immediately become useless whenever their conductors or horses were wounded.

"Having thus arranged the several parts, Alexander with equal judgment led the whole in an oblique direction towards the enemy's left; a manœuvre which enabled the Macedonians to avoid contending at once with superior numbers. When his advanced battalions, notwithstanding their nearness to the enemy, still stretched towards the right, Darius also extended his left, till fearing that by continuing this movement his men should be drawn gradually off the plain, he commanded the Scythian squadrons to advance, and prevent the farther extension of the hostile line. Alexander immediately detached a body of horse to oppose them. An equestrian combat ensued, in which both parties were reinforced, and the barbarians finally repelled. The armed chariots then issued forth with impetuous violence; but their appearance only was formidable; for the precautions taken by Alexander rendered their assault harmless. Darius next moved his main body, but with so little order, that the horse, mixed with the infantry, advanced, and left a vacuity in the line, which his generals wanted time or vigilance to supply. Alexander seized the decisive moment, and penetrated into the void with a wedge of squadrons. He was followed by the nearest sections of the phalanx, who ruſhed forward with loud ſhouts, as if they had already purſued the enemy. In this part of the field, the victory was not long doubtful; after a feeble reſiſtance, the barbarians gave way; and the puſillanimous Darius was foremoſt in the flight.

"The battle, however, was not yet decided. The more remote diviſions of the phalanx, upon receiving intelligence that the left wing, commanded by Parmenio, was in danger, had not immediately followed Alexander. A vacant ſpace was thus left in the Macedonian line, through which ſome ſquadrons of Perſian and Indian horſe penetrated with celerity, and advanced to the hoſtile camp. It was then that Alexander derived ſignal and well-earned advantages from his judicious order of battle. The heavy-armed troops and targeteers, which he had ſkilfully poſted behind the phalanx, ſpeedily faced about, advanced with a rapid ſtep, and attacked the barbarian cavalry, already entangled among the baggage. The enemy, thus ſurpriſed, were deſtroyed or put to flight. Meanwhile, the danger of his left wing recalled Alexander from the purſuit of Darius. In advancing againſt the enemy's right, he was met by the Parthian, Indian, and Perſian horſe, who maintained a ſharp conflict. Sixty of the *Companions* fell: Hephæſtion, Cœnus, and Menidas, were wounded. Having at length diſſipated this cloud of cavalry, Alexander prepared to attack the foot in that wing. But the buſineſs was already effected, chiefly by the Theſſalian horſe; and nothing remained to be done, but to purſue the fugitives, and to render the victory as deciſive as poſſible.

"According to the leaſt extravagant accounts, with the loſs of 500 men he deſtroyed 40,000 of the barbarians, who never thenceforth aſſembled in ſufficient numbers to diſpute his dominion in the Eaſt. The invaluable provinces of Babylonia, Suſiana, and Perſis, with their reſpective capitals of Babylon, Suſa, and Perſepolis, formed the prize of his ſkill and valour. The gold and ſilver found in thoſe cities amounted to thirty millions Sterling; the jewels and other precious ſpoil, belonging to Darius, ſufficed, according to Plutarch, to load 20,000 mules and 5000 camels." The conſequence of this victory the reader will find narrated under the article Persia.

ARBERG, a town of Swiſſerland, in the canton of Bern, with a handſome caſtle, where the bailiff reſides. It is ſeated on the river Aar, in a kind of iſland. E. Long. 17. 15. N. Lat. 47. 0.

ARBITER, in the civil law, implies a judge nominated by the magiſtrate, or choſen voluntarily by the two contending parties, in order to decide their differences.

The civilians make a difference between *arbiter* and *arbitrator*, though both found their power on the compromiſe of the parties; the former being obliged to judge according to the cuſtoms of the law, whereas the latter is at liberty to uſe his own diſcretion, and accommodate the difference in the manner that appears to him moſt juſt and equitable.

ARBITRARY, that which is left to the choice or arbitration of men, or not fixed by any poſitive law or injunction.

Arbitrary Puniſhment, in law, denotes ſuch puniſhments as are by ſtatute left to the diſcretion of the judge. It is a general rule in arbitrary puniſhments, that the judge cannot inflict death. Hence all puniſhments that are not capital have acquired the name of *arbitrary puniſhments*, even although they be expreſsly pointed out by ſtatute.

ARBITRATION is where the parties, injuring and injured, ſubmit all matters in diſpute, concerning any perſonal chattels, or perſonal wrong, to the judgment of two or more arbiters or arbitrators; who are to decide the controverſy: and if they do not agree, it is uſual to add, that another perſon be called in as umpire, (*imperator* or *impar*), to whoſe ſole judgment it is then referred; or frequently there is only one arbitrator originally appointed. This deciſion, in any of theſe caſes, is called an *award*. And thereby the queſtion is as fully determined, and the right transferred or ſettled, as it could have been by the agreement of the parties or the judgment of a court of juſtice. See alſo Law, Part III. N° clxxxv. 15, &c.

ARBITRATOR, a private extraordinary judge, choſen by the mutual conſent of parties, to determine controverſies between them. See Arbiter and Arbitration.

ARBOIS, a ſmall populous town of France, in the Franche Compte, famous for its wines. E. Long. 5. 40. N. Lat. 46. 55.

ARBON, an ancient town in Swiſſerland, on the ſouth banks of the lake Conſtance, in Thurgaw. It has a caſtle built by the Romans, and is under the juriſdiction of the biſhop of Conſtance. In the time of war, the Swiſs have a right to put in a garriſon. The Popiſh and Proteſtant religions are equally tolerated in this town. E. Long. 9. 30. N. Lat. 4. 38.

ARBOR, in botany, a tree. Trees are by Linnæus claſſed in the ſeventh family of the vegetable kingdom, and are diſtinguiſhed from ſhrubs in that their ſtems come up with buds on them; but this diſtinction holds not univerſally, there being rarely any buds on the large trees in India.

Arbor, in mechanics, the principal part of a machine, which ſerves to ſuſtain the reſt; alſo the axis or ſpindle on which a machine turns, as the *arbor* of a crane, windmill, &c.

Arbor Dianæ. See Chemistry-*Index*.

Arbor Vitæ. See Thuya.

ARBORESCENT, an epithet applied to ſuch objects as reſemble trees.

Arborescent Star-fiſh, in zoology, a ſpecies of aſterias. See Asterias.

ARBORIBONZES, in modern hiſtory, prieſts of Japan, who live an erratic life, and ſubſiſt on alms. They dwell in caverns, and cover their heads with bonnets made of the bark of trees.

ARBORIST, a perſon ſkilled in that part of botany which treats of trees.

ARBOUR, in gardening, a kind of ſhady bower, formerly in great eſteem; but of late rejected on account of its being damp and unwholeſome.

Arbours are generally made of lattice-work, either of wood or iron; and covered with elms, limes, hornbeams; or with creepers, honeyſuckles, jaſmines, or paſſion-flowers; either of which will anſwer the purpoſe very well, if rightly managed.

ARBROATH, See Aberbrothic.

ARBURG, a town of Swiſſerland, in the canton of Bern, on the river Aar. It is ſmall, but very ſtrong, being seated on a rock, and defended by a good fortress cut out of the rock. E. Long. 17. 55. N. Lat. 47. 10.

ARBUSCULA is used by Bradley to denote a little or dwarf tree, above the rank of shrubs but below that of trees; such e. gr. as the elder.

ARBUSTUM implies a number or multitude of trees planted for the fruit sake.

The word was more peculiarly applied to a place planted with trees for fastening vines to, which are hence called by Columella *arbustivæ*.

ARBUSTUM is sometimes also used to denote an orchard, or field wherein trees are planted at such distance that there is room for ploughing and growing corn between.

ARBUTHNOT (Alexander), principal of the university of Aberdeen in the reign of James VI. of Scotland, was born in the year 1538. He studied first at Aberdeen; and was afterwards sent over to France, where, under the famous Cujacius, he applied himself to the study of the civil law. In the year 1563, he returned to Scotland, and took orders. Whether he was ordained by a bishop or by presbyters, is a matter of uncertainty. In 1568, he was appointed minister of Arbuthnot and Logy-Buchan; and in the following year, Mr Alexander Anderson being deprived, our author was made principal of the king's college at Aberdeen in his room. In the general assembly which met at Edinburgh in the years 1573 and 1577, he was chosen moderator; and to the end of his life was an active supporter of the reformed religion. He died in 1583, in the 45th year of his age; and was buried in the college church of Aberdeen. We are told in the Biographia, that he was eminent as a poet, a philosopher, a mathematician, a lawyer, a divine, and a physician. He wrote *Orationes de origine & dignitate juris*, printed at Edinburgh, 1572, 4to. His cotemporary Thomas Maitland wrote a copy of Latin verses on the publication of this book: they are printed in the *Delic. Poetar. Scot.* He published Buchanan's history of Scotland in the year 1582.

ARBUTHNOT (Dr John), was born in Kincardinshire, near Montrose, and was educated at Aberdeen, where he received his degree in physic. The difficulties in which his family was involved on account of their political principles, making it necessary that he should court preferment in another country than his own, he went to London. The first character in which he acted there was a teacher of the mathematics; and while he was employed in this manner, he had occasion to publish his *Examination of Dr Woodward's account of the deluge*. This tract, which abounded with learning and good sense, served to make him known. He published soon after his *Essay on the usefulness of mathematics*. In the profession of physic he advanced by slow but sure degrees; and his reputation in it was at length fully established, by a successful cure which he performed on Prince George of Denmark. Queen Anne, in consequence of it, appointed him one of her physicians in ordinary in 1709; and, some years before this, his extensive knowledge had procured his admission into the Royal Society. His talents and worth were the strongest recommendations of him to the men of wit and learning of his day; and he entered into particular connection with Pope and Swift, with whom he joined in publishing several volumes of miscellanies; among which are the well-known *Memoirs of Martinus Scriblerus*, a satire of infinite humour on the abuses of human learning. In 1715, he assisted Pope and Gay in the *Three hours after marriage*; a dramatic performance, which was brought upon the stage without success. In 1727, he published *Tables of ancient coins, weights, and measures*; a work of great use, and real erudition. In 1732, his valuable tract concerning *The nature and choice of aliments* appeared; which, the year after, was followed by his remarks on *The effects of air on human bodies*. A constitutional asthma had distressed him at different periods of his life, and proved fatal to him in 1734.—Dr Arbuthnot appears to have been in all respects a most accomplished and amiable person. He has showed himself equal to any of his cotemporaries in wit and learning, and he was superior to most men in the moral duties of life, in acts of humanity and benevolence. His letter to Mr Pope, written as it were upon his death-bed, and which no one can read without the tenderest emotion, discovers such a noble fortitude of mind at the approach of his dissolution, as could be inspired only by a clear conscience, and the calm retrospect of an uninterrupted course of virtue. In 1751, came out in two vols. 8vo. printed at Glasgow, *The miscellaneous works of the late Dr Arbuthnot*; which are said to comprehend, with what is inserted in Swift's miscellanies, all the pieces of wit and humour of this admirable author.

ARBUTUS, the STRAWBERRY TREE: a genus of the monogynia order, belonging to the decandria class of plants; and in the natural method ranking under the 18th order, *Bicornes*. The calyx is divided into five parts; the corolla is ovated; and the fruit is a berry with five cells.

Species. 1. The unedo, or common strawberry-tree, is a native of Italy, Spain, and also of Ireland; and is now very common in the British gardens. Of this species there are four varieties, viz. The oblong-fruited, the round-fruited, the red-flowered, and the double-blossomed. One description is nearly common to them all; and their inconsiderable variation is almost sufficiently shewn in their respective appellations.

The oblong-fruited sort will grow to be a middling-sized tree in some countries; for we read of the large uses its wood has been applied to; such as, *arbutæ crates*, &c. Arbutean harrows, &c. With us it may be kept down to any size. The main stems are covered with a light-brown bark, rough, and falling. The younger branches are of a kind of purple colour, whilst the last year's shoots are of a fine red, and a little hairy. The leaves grow alternately on the branches, and are of an oblong oval figure. They stand on short footstalks, and the oldest leaves make a contrast with the younger by having their footstalk and mid-rib of a fine scarlet colour. They are smooth, and beautifully serrated. Their upper surface (as in most trees) is of a stronger green than their under; and the young twigs are garnished with them in plenty. These are beauties in common to most trees, in some degree or other; but every thing else almost of this tree that presents itself to consideration is singular: the time of its flowering will be in November and December; when it is rather singular to see a tree in the open ground in full blow; and the fruit ripens by that time twelvemonth after. The manner and nature of the fruit, Arbutus. fruit, which look like very large red ſtrawberries, give it alſo a ſingular and delightful look; and this is heightened as they appear all over the tree among the flowers; for that is the time of its being ripe, when the flowers for the ſucceeding crop are fully out. The flowers themſelves make no great figure; they are of a kind of whitiſh-yellow colour; and are ſucceeded by the abovementioned ſtrawberry-fruit, which will require a revolution of twelve months before they perfectly arrive at their maturity and colour. The flowers of the firſt ſort are larger than thoſe of the ſecond; and the fruit is oval, and much larger than our common ſcarlet ſtrawberry.

The round-fruited ſort has its pitcher-ſhaped flowers, which are ſucceeded by round ſcarlet fruit, as wide as they are long; and this is all the difference between theſe ſorts.

The red-flowered ſort differs in no reſpect from the common ſort, only the flowers are red, and theſe conſtitute a variety from the other ſorts of flowers; but the contraſt is not ſo great between their fruit and them as of the other ſorts, their colour approaching too near to a ſameneſs.

The double-bloſſomed ſort differs in no reſpect, only that the flowers are double; but this difference is ſo inconſiderable, that it will not be ſeen without looking into the flower; and even then the doubleneſs will appear ſo trifling as ſcarcely to merit notice; ſo that a plant or two, to have it ſaid that the collection is not without it, will be ſufficient. Neither ought any more to be admitted; for they will not produce the ſame plenty of fruit, which conſtitutes the greateſt beauty of theſe trees, as the ſingle ſorts.

The above ſorts thrive beſt in a wet ſoil, and are ſeldom hurt by hard winters, though the young and tender branches are often deſtroyed by froſt; but, however dead the trees may appear, they ought always to be ſuffered to remain till the following ſummer ſhows what are living and what are dead.

The method of propagating the varieties of the unedo is by layers and cuttings: the ſpecies itſelf may be raiſed from ſeed.—1. *Propagation by layers.* The operation muſt be performed on the youngeſt twigs; and in ſome ſoils they will ſtrike root pretty freely, whilſt in others they can hardly be made to grow at all: But before they have lain two ſummers, you may ſcarcely venture to look for any. When the roots are ſtruck, the layers ſhould be carefully taken off in the ſpring, and planted in ſeparate pots; and after well watering them, they ſhould be plunged up to the rims in an hotbed, and this will ſet them forward; for without this aſſiſtance many of the layers will be loſt; ſince they are difficult plants to make grow. After the hotbed has forced the ſeeds into a ſtate of vegetation, the pots may be taken out, and plunged up to the rims in ſome natural mould, to keep them cool and moiſt; and here they may ſtand for two or three years, or longer, if the pots are large enough, without ever removing or ſheltering in winter; for they are hardy enough to reſiſt our ſevereſt cold. When they are to be finally ſet out, all the mould may be turned out of the pots hanging to the roots; and having proper holes made ready, they may be planted in them, and the plant will be ignorant of its new ſituation.

2. *By cuttings.* Theſe muſt be planted in pots, and have the benefit of a good bark-bed; in which being conſtantly ſhaded and duly watered, many of them will grow. As the plants raiſed this way will be rather tender by being forced in the bark-bed, it will be neceſſary to remove them into the greenhouſe, or to place them under a hotbed-frame during the firſt winter: and after that, the pots may be ſet up to the rims in the ground, and, like the layers, the plants may be turned out at a convenient time into the places where they are to remain. Arbutus.

1. *Raiſing from ſeeds.* Let theſe be taken from the oblong or round-fruited ſort. The ſeeds, which will be ripe ſome time in November or the beginning of December, for they will not be ripe at the ſame time in all places, muſt be then gathered; and as they ſhould not be ſowed until the ſpring, it will be proper to put them into a pot or jar, mixing with them a quantity of drift-ſand; and this will preſerve them ſound and good. The beginning of March is the beſt time for ſowing the ſeeds; and the beſt ſoil for them is maiden earth, taken from a rich paſture at leaſt a year before, with the ſward; and this, by conſtant turning, being well rotted and mixed, will be ready to receive them. Having filled a different quantity of pots with this fine mould, let the ſeeds be ſown, and but juſt covered, ſcarcely a quarter of an inch deep. A dry day ſhould be choſen for the buſineſs; and no watering by the hand ſhould be given them, as it will endanger the ſetting the mould hard in the pots. Leave them abroad until ſome rain falls, which at that time may be hourly expected; and after that, having an hotbed ready, plunge the pots therein. In leſs than ſix weeks you may expect your plants to appear; when much air ſhould be afforded them, and frequent waterings, in ſmall quantities, gently ſprinkled over them. After this, they may be hardened to the air by degrees, and the pots ſet up to the rims in the natural mould, in a ſhady place. In October they ſhould be removed into the greenhouſe, or ſome ſhelter, in froſty weather; though they ſhould always be ſet abroad in mild open weather. In the ſpring they may be taken out, and planted in ſeparate pots; and they ſhould have the advantage alſo of a hotbed to ſet them a-growing: their future management may be the ſame as was directed for the layers. When theſe trees are to be planted out, very little regard need be paid to the ſoil or ſituation; for they will grow almoſt any where, and reſiſt our ſevereſt northern blaſts. One thing, however, the gardener muſt conſtantly obſerve, in order to continue his trees in their beauty, viz. As often as a heavy ſnow falls, ſo conſtantly ſhould he go and ſhake the boughs; for it will lodge amongſt the leaves and branches in ſuch great quantity as to weigh down and ſplit the largeſt branches; the deformity of which afterwards may be eaſily conceived. Beſides, many years muſt expire before the tree will, if ever it ſhould, grow to its former beauty; to preſerve this, therefore, makes the narrowly watching theſe trees in ſnowy weather highly neceſſary.

2. The andrachne will grow to a larger ſize than the arbutus. The leaves are ſmooth, and nearly of the ſame figure as the preceding ſort; though they are larger, and have their edges undivided. The flowers grow like the other ſorts; are of the ſame colour; and they

they are succeeded by large, oval, scarlet fruit. It is called the *Oriental Strawberry-tree*, because this sort grows plentifully in many parts of the East, and is useful to the inhabitants for many purposes in life.

The andrachne may be propagated in the same manner as the arbutus: But the plants must be preserved in pots for three or four years till they have obtained strength; and may be then planted in a warm situation and on a dry soil, for this species will not thrive on wet ground.

Besides the above, there are three other species of arbutus, viz. The acadiensis, a native of Acadia; the alpina, or mountain strawberry-tree, a native of Britain; and the uva ursi, a plant lately discovered in the Highlands of Scotland, and which formerly was thought not to be a native of Britain.

ARCADE, in architecture, is used to denote any opening in the wall of a building formed by an arch.

ARCADI, or ARCADIANS, the name of a learned society at Rome. See the article ACADEMY.

ARCADIA, an inland district in the heart of Peloponnesus (Strabo). It is mountainous, and fitter for pasture than corn; and therefore chiefly celebrated by bucolic or pastoral poets, who feign Pan, the god of shepherds, to be the guardian of it (Virgil.) It has to the north Achaia, to the east Argos and Laconia, Messenia to the south, and Elis to the west. According to Pliny, the wine of this country cured barenness in women, and inspired the men with rage; and the berries of the yew gathered there were so strong a poison, that whoever slept or took refreshment under that tree were sure to die. In Strabo's time there were few cities remaining in it, most of them being destroyed in the Grecian wars. Eustathias says, that the country was anciently called *Pelasgia*, from Pelasgos, who brought the people, from roots, herbs, and leaves of trees, to feed on acorns, especially beech-mast; as Artemidorus observes, that the Arcadians usually lived on acorns. It was also called *Lycaonia*, *Gigantis*, and *Parrhasia* (Stephanus). The Arcadians are greatly commended for their love of, and skill in, music (Virgil, Polybius). To imitate the Arcadians, is to labour and toil for the benefit of others, never conquering their own, but the enemies of others (Hesychius). This probably took its rise from the ancient Arcadians being accustomed to hire themselves out as mercenaries to foreign nations. Homer commends their martial prowess, their pastures, their sheep, and their country well-watered. The gentilitious name is *Arcades;* who boasted of their great antiquity, and that they were older than the sun and moon (Apollonius Rhodius, Nonnius, Plutarch, Ovid, Statius). They were the first who had a year of three months, and therefore called *Proceleni*, because their year was prior to that adjusted in Greece to the course of the moon (Censorinus).

ARCANGIS, in the Turkish armies, an inferior kind of infantry, which serve as *enfans perdus*, and to harrass and pillage the enemy's frontiers. The Arcangis are an order inferior to the Janisaries; and when any of them distinguish themselves, are usually preferred into the Janisaries order. They have no pay, but are to subsist on their plunder.

ARCANUM, among physicians, any remedy, the preparation of which is industriously concealed, in order to enhance its value.

ARCANUM (anc. geog.), a villa of Q. Cicero, Tully's brother, in Latinum, (Cicero). Now Arce, in the Terra di Lavoro, in the kingdom of Naples, on the borders of the Campagnia di Roma, on the river Melpis, between Arpinum and Aquinum.

ARCBOUTANT, in building, an arched buttress. See BUTTRESS.

ARCESILAUS, a celebrated Greek philosopher, about 300 years before the Christian æra, was born at Pitane, in Eolis. He founded the second academy, which is called the *second school*. He was a man of great erudition, and well versed in the writings of the ancients. He was remarkable for the severity of his criticisms; but nevertheless he knew how to accommodate himself to the age, and pursue the allurements of pleasure. He had a great number of disciples. His doctrines were different in several respects from those of the ancient school: and perhaps he was led into this diversity of opinions by many capital errors in the ancient school, such as the incredible arrogance of the dogmatists, who pretended to assign causes for all things; the mysterious air they had thrown upon the doctrine of ideas; the entirely discarding the testimony of the senses; the objections of the Pyrrhonists, who now began to broach their opinions; the powerful opposition of the Stoics and Peripatetics, who discovered the feeble parts of the academic philosophy. These might have given cause to reform the ancient school, and to found a new one. The middle school, therefore, laid it down as a principle, that we could know nothing, nor even assure ourselves of the certainty of this position; from whence they inferred, that we would affirm nothing, but always suspend our judgment. They advanced, that a philosopher was able to dispute upon every subject, and bring conviction with him, even upon contrary sides of the same question; for there are always reasons of equal force both in the affirmative and negative of every argument. According to this doctrine, neither our senses, nor even our reason, are to have any credit; and therefore, in common affairs, we are to conform ourselves to received opinions. Arcesilaus was succeeded by his disciple Lacydes.

ARCH, in geometry, any part of the circumference of a circle or curved line, lying from one point to another, by which the quantity of the whole circle or line, or some other thing sought after, may be gathered.

ARCH, a concave or hollowed piece of building, constructed in such a manner that the several stones of which it is composed keep one another in their places. The terms *arch* and *vault* properly differ only in this, that the arch expresses a narrower, and the vault a broader, piece of the same kind. The principal difference in the form of arches is, that some are circular, and others elliptical; the former having a larger or smaller part of a circle, the other of an ellipsis. What are called *strait arches*, are those frequently used over doors and windows, the upper and under edges of which are strait and parallel, and the ends and joints all pointing toward a centre. The space between two piers of a bridge is called an *arch*, because usually arched over.

Triumphal ARCHES are magnificent entries into cities, erected to adorn a triumph, and perpetuate the memory of the action. The arches of Titus and Constantine ftantine make at this time a great figure among the ruins of old Rome.

Arch, in compofition, fignifies *chief*, or of the *firft* clafs; as archangel, archbifhop, &c.

ARCHÆUS, or Archeus. See Archeus.

ARCHANGEL, an angel occupying the eighth rank in the celeftial hierarchy. See Angel and Hierarchy.

Archangel, a city of Ruffia, in the province of Dwina, fituated on the eaft fide of the river Dwina, about fix miles from the White Sea, in E. Long. 40. 21. N. Lat. 64. 30. The city extends about three miles in length and one in breadth. It is rich, populous, built in the modern tafte, and is a metropolitan fee. It rofe from a caftle built on the fpot by Bafilowitz II. to protect the increafing trade brought there by the difcovery of the White Sea by the Englifh, and took its name from a monaftery built in honour of the archangel Michael. Before this period the commercial intercourfe between Ruffia and the northern parts of Europe had been long carried on by the Hanfeatic towns; which ufually failed to Revel or Narva, and from thence paffed through Dorpt to Plefcof and Novogorod, where their factories were eftablifhed. The accidental difcovery of archangel, in 1553, deprived the Hanfeatic towns of a great part of this lucrative commerce, and transferred it to the Englifh. On the 11th of May, in the abovementioned year, three fhips failed from Deptford, in order to explore the northern feas, under the command of Sir Hugh Willoughby. Two of thefe veffels penetrated as high as the 72d degree of latitude, to the coaft of Spitzbergen; and being afterwards forced by ftrefs of weather into the bay of the river Arzina in Ruffian Lapland, both their crews were frozen to death. Richard Chancellor, who commanded the other fhip, called the Bonaventure, difcovering the country bordering upon the White Sea, landed near the mouth of the Dwina, in a bay, which he denominated the *Bay of St Nicholas*, from a convent of that name, near the prefent port of Archangel. The czar Iwan Bafilowitz, being informed of his arrival, invited him to his court, where he was hofpitably entertained; and the czar indulged the Englifh with a free trade in his dominions: in confequence of this permiffion, a company of merchants was incorporated in London; and being encouraged by particular privileges from the czar, fet on foot a confiderable commerce, to the mutual advantage of both nations. This traffic the Englifh for fome time enjoyed without competition. The Dutch, however, and other nations, gradually infinuated themfelves into this commerce; which they carried on to a very great difadvantage, as not being favoured with thofe privileges which the czar had granted to the Englifh company. Thefe were at laft fuddenly annihilated by Alexis Michaelovitch; who in 1648 banifhed the Englifh merchants from all his dominions. The caufe of this expulfion is generally imputed to the refentment which the czar conceived againft the Englifh for the execution of Charles I. with whom he was clofely connected by leagues of amity and alliance: but in effect he abolifhed the company's privileges in the year before that event; and his indignation againft the Englifh for their rebellion, Mr Coxe affirms, was only a political pretext; the real motive being derived from the offers made by the Dutch to pay duties of export and import, to the amount of 15 *per cent.* if they were indulged with the liberty of carrying on as free a trade as the Englifh throughout his dominions. For not long afterwards, the czar fuffered William Prideaux, Cromwell's agent, to refide at Archangel; and permitted the Englifh to renew their commerce in that port upon the fame footing with other foreigners. And upon this footing alone our merchants ever after continued to trade.

The commodities chiefly imported into Archangel, were gold and filver ftuffs and laces, gold wire, cochineal, indigo, and other drugs for dyeing; wine, brandy, and other diftilled fpirits. The cuftoms arifing to the czar were computed at 200,000 rubles a-year, and the number of foreign fhips at 400 annually. But upon the building of Peterfburg, Peter the Great abolifhed the immunities of Archangel, and removed the commerce of the White Sea to the havens of the Baltic. Still, however, its exports of tar were confiderable; in 1730, to the amount of 40,000 lafts, of 11 barrels each. It fends, during winter, great quantities of the rawaga, a fmall fpecies of three-finned cod, to Peterf burg frozen.

In 1752 Elizabeth again reftored the ancient immunities of Archangel; and its prefent trade is not inconfiderable. It fupplies the government of Archangel, part of thofe of Nifhnei-Novogorod and Cafan, with European commodities; and draws in exchange from thofe parts corn, flax, hemp, coarfe linen, cordage, fails, mafts, and tallow, which are moftly conveyed by the Dwina: it forms alfo a principal communication with the northern and weftern parts of Siberia, from whence the merchants procure furs, fkins, and iron.

The houfes of Archangel are generally of wood, but well contrived; and every chamber is provided with a ftove, as a fence againft the cold, which is here exceffive in the winter. The ftreets are paved with broken pieces of timber and rubbifh, difpofed fo unfkilfully, that one cannot walk over it without running the rifk of falling, except when the ftreets are rendered fmooth and equal by the fnow that falls and freezes in the winter. Notwithftanding the feverity of the cold in this place, there is always plenty of good provifions; butcher's meat, poultry, wild fowl, and fifh, in great variety, are fold furprifingly cheap.

The moft remarkable edifice in Archangel is a large town-houfe, built of fquare ftones in the Italian manner, and divided into three parts. One of thefe confifts of large commodious apartments, for the accommodation of merchants, ftrangers as well as natives: here they are permitted to refide with their merchandife till the month of October, when all the foreign fhips fet fail for the refpective countries to which they belong. Then the traders are obliged to remove their quarters from the town-houfe or palace, which hath a fpacious court, that reaches down to the river.

ARCHBISHOP, the name of a church dignitary of the firft clafs. Archbifhops were not known in the eaft till about the year 320; and though there were fome foon after this who had the title, yet that was only a perfonal honour, by which the bifhops of confiderable cities were diftinguifhed. It was not till of late that archbifhops became metropolitans, and had fuffragans under them. Athanafius appears to be the firft who ufed the title *Archbifhop*, which he gave occafionlly casionally to his predecessor; Gregory Nazianzen, in like manner, gave it to Athanasius; not that either of them were intitled to any jurisdiction, or even any precedence in virtue of it. Among the Latins, Isidore Hispalensis is the first that speaks of archbishops. He distinguishes four orders or degrees in the ecclesiastial hierarchy, viz. patriarchs, archbishops, metropolitans, and bishops.

The archbishop, beside the inspection of the bishops and inferior clergy in the province over which he presides, exercises episcopal jurisdiction in his own diocese. He is guardian of the spiritualites of any vacant see in his province, as the king is of the temporalities; and exercises ecclesiastical jurisdiction in it. He is intitled to present by lapse to all the ecclesiastical livings in the disposal of his diocesan bishop, if not filled within six months. He has likewise a customary prerogative, upon consecrating a bishop, to name a clerk or chaplain to be provided for by such bishop; in lieu of which it is now usual to accept an option. He is said to be enthroned when vested in the archbishopric; whereas bishops are said to be installed.

The ecclesiastical government of England is divided into two provinces, viz. Canterbury and York. Canterbury hath the following suffragan bishoprics appertaining to it, St Asaph, Bangor, Bath and Wells, Bristol, Chichester, Litchfield and Coventry, St David's, Ely, Exeter, Gloucester, Hereford, Landaff, Lincoln, London, Norwich, Oxford, Peterborough, Rochester, Salisbury, Winchester, and Worcester. To York appertaineth the bishoprics of Carlisle, Chester, and Durham; to which may be added the bishopric of Sodor and Man, whose bishop is not a Lord of Parliament. See CANTERBURY and YORK.

The archbishop of Canterbury had anciently, viz. till the year 1152, jurisdiction over Ireland as well as England, and was styled a *patriarch*, and sometimes *alterius orbis papa*, and *orbis Britannici pontifex*. Matters were done and recorded in his name thus, *Anno pontificatus nostri primo*, &c. The first archbishop of Canterbury was Austin, appointed by king Ethelbert, on his conversion to Christianity, about the year 598. He was also *legatus natus*. He even enjoyed some special marks of royalty; as, to be patron of a bishopric, which he was of Rochester; and to make knights, coin moneys, &c. He is still the first peer of England, and the next to the royal family; having precedence of all dukes and all great officers of the crown. It is his privilege, by custom, to crown the kings and queens of that kingdom. He may retain and qualify eight chaplains; whereas a duke is by statute allowed only six. He has, by common law, the power of probate of wills and testaments, and granting letters of administration. He has also a power to grant licences and dispensations in all cases formerly sued for in the court of Rome, and not repugnant to the law of God. He accordingly issues special licences to marry, to hold two livings, &c. and he exercises the right of conferring degrees. He also holds several courts of judicature; as, court of arches, court of audience, prerogative court, and court of peculiars.

The archbishop of York has the like rights in his province as the archbishop of Canterbury. He has precedence of all dukes not of the royal blood; and of all officers of state, except the lord high chancellor. He has also the rights of a count palatine over Hexamshire. The first archbishop of York was Paulinus, appointed by Pope Gregory about the year 622. He had formerly jurisdiction over all the bishops of Scotland; but in the year 1470, pope Sextus IV. created the bishop of St Andrew's archbishop and metropolitan of all Scotland.

Scotland, whilst episcopacy prevailed in that country, had two *archbishops*, of St Andrew's and Glasgow; of which the former was accounted the metropolitan; and, even before it arrived at the dignity of an archbishopric, resisted with great spirit all the attempts of the archbishops of York in England to become the metropolitans of Scotland. The sees of Argyle, Galloway, and the Isles, were suffragans to Glasgow; all the others in the kingdom, to St Andrew's.

Ireland has four archbishops; of Armagh, Dublin, Cassil, and Tuam; of whom the former is primate of all Ireland.

ARCHBISHOPRIC, in ecclesiastical geography, a province subject to the jurisdiction of an archbishop.

ARCHBUTLER, one of the great officers of the German empire, who presents the cup to the emperor on solemn occasions. This office belongs to the king of Bohemia.

ARCHCHAMBERLAIN, an officer of the empire, much the same with the great chamberlain in England. The elector of Brandenburg was appointed by the golden bull archchamberlain of the empire.

ARCHCHANCELLOR, an high officer who, in ancient times, presided over the secretaries of the court. Under the two first races of the kings of France, when their territories were divided into Germany, Italy, and Arles, there were three archchancellors: and hence the three archchancellors still subsisting in Germany; the archbishop of Mentz being archchancellor of Germany, the archbishop of Cologn, and the archbishop of Treves.

ARCHCHANTOR, the president of the chantors of the church.

ARCHCOUNT, a title formerly given to the earl of Flanders, on account of his great power and riches.

ARCHDEACON, an ecclesiastical dignitary or officer next to a bishop, whose jurisdiction extends either over the whole diocese or only part of it. He is usually appointed by the bishop himself; and hath a kind of episcopal authority, originally derived from the bishop, but now independent and distinct from his. He therefore visits the clergy; and has his separate court for punishment of offenders by spiritual censures, and for hearing all other causes of ecclesiastical cognizance. There are 60 archdeacons in England.

ARCHDEACON's Court, is the most inferior court in the whole ecclesiastical polity. It is held, in the archdeacon's absence, before a judge appointed by himself, and called his *official*; and its jurisdiction is sometimes in concurrence with, sometimes in exclusion of, the bishop's court of the diocese. From hence, however, by statute 24 Hen. VIII. c. 12. there lies an apeal to that of the bishop.

ARCHDRUID, the chief or pontiff of the ancient druids of a nation. See DRUID.

ARCHDUKE, a title peculiar to the House of Austria; all the sons of which are archdukes, and daughters archduchesses. See DUKE.

ARCHELAUS, a celebrated Greek philosopher, the

the disciple of Anaxagoras, flourished about 440 years before Christ. He read lectures at Athens, and did not depart much from the opinions of his master. He taught that there was a double principle of all things, namely, the *expansion* and *condensation* of the air, which he regarded as infinite. Heat, according to him, was in continual motion. Cold was ever at rest. The earth, which was placed in the midst of the universe, had no motion. It originally resembled a wet marsh, but was afterwards dried up; and its figure, he said, resembled that of an egg. Animals were produced from the heat of the earth, and even men were formed in the same manner. All animals have a soul, which was born with them; but the capacities of which vary according to the structure of the organs of the body in which it resides.—Socrates, the most illustrious of his disciples, was his successor.

Archelaus, the son of Herod the Great, was declared king of Judea the second year after the birth of Christ. He put to death 3000 persons before he went to Rome to be confirmed by Augustus. However, that emperor gave him half of what had been possessed by his father; but at length, on fresh complaints exhibited against him by the Jews, he banished him to Vienne in Gaul, A. D. 6, where he died.

Archelaus, the son of Apollonius, one of the greatest sculptors of antiquity, was a native of Ionia, and is thought to have lived in the time of the emperor Claudius. He executed, in marble, the apotheosis of Homer. This masterpiece in sculpture was found in 1568, in a place named *Fratocchia*, belonging to the princes of Colonna, where, it is said, the emperor Claudius had a pleasure-house. Father Kircher, Cupert, Spanheim, and several other learned antiquaries, have given a description and explication of the work.

ARCHERS, a kind of militia or soldiery armed with bows and arrows. The word is formed of *arcus* "a bow;" whence *arcuarius*, and even *arquis*, and *arquites*, as they are also denominated in the corrupt state of the Latin tongue.

Archers were much employed in former times: but they are now laid aside, excepting in Turkey and some of the eastern countries; where there are companies of archers still subsisting in their armies, and with which they did terrible execution at the battle of Lepanto.—As an exercise, the practice of archery is still kept up in many places. See the article Archery.

In France, the officers who attend the lieutenants de police and provosts to make captures, seizures, arrests, &c. are called *archers*; though their arms be only halberds or carabines.—In this sense they say, the *archers* of the *grand prevot de l'hotel*; of the *prevot des marchands*; the city *archers*; the *archers du guet*, or of the watch, &c.—Small parties of *archers*, called also *gens de marechaussee*, are continually patrolling on the great roads, to secure them against robbers.—The carriages of Lyons, &c. are always escorted by a party of archers. To the diligence of these archers, or marshal's-men, it is partly owing, that persons now travel in all parts of France in the utmost security; there being fewer robbers on the highway in that whole kingdom in a year than about London in a week.

ARCHERY, the art or exercise of shooting with a bow and arrow.

In most nations the bow was anciently the principal implement of war, and by the expertness of the archers alone was often decided the fate of battles and of empires.—In England archery was greatly encouraged in former times, and many statutes were made for the regulation thereof; whence it was that the English archers in particular became the best in Europe, and procured them many signal victories.

The *Artillery company* of London, though they have long disused the weapon, are the remains of the ancient fraternity of bowmen or archers. Artillery (*artillérie*) is a French term signifying *archery*; as the *king's bowyer* is in that language styled *artillier du roy*: And from that nation the English seem to have learnt at least the cross-bow archery. We therefore find that William the Conqueror had a considerable number of bowmen in his army at the battle of Hastings, when no mention is made of such troops on the side of Harold: And it is supposed that these Norman archers shot with the arbalest (or cross-bow), in which formerly the arrow was placed in a groove, being termed in French a *quadrel*, and in English a *bolt*. *Archæologia* vol. vii.

Of the time when shooting with the long bow first began among the English, at which exercise they afterwards became so expert, there appear no certain accounts. Their chroniclers do not mention the use of archery as expresly applied to the cross-bow, or the long-bow, till the death of Richard I. who was killed by an arrow at the siege of Limoges in Guienne, which Hemmingford mentions to have issued from a cross-bow.—After this, which happened in 1196, there appear not upon record any notices of archery for nearly 150 years, when an order was issued by Edward III. in the 15th year of his reign, to the sherives of most of the English counties for providing 500 white bows and 500 bundles of arrows, for the then intended war against France. Similar orders are repeated in the following years; with this difference only, that the sheriff of Gloucestershire is directed to furnish 500 painted bows as well as the same number of white. The famous battle of Cressy was fought four years afterwards, in which the English chroniclers state that they had 2000 archers, who were opposed to about the same number of the French, together with a circumstance which seems to prove, that by this time they used the long-bow, whilst the French archers shot with the arbalest. The circumstance alluded to is as follows: Previously to the engagement there fell a very heavy rain, which is said to have much damaged the bows of the French, or perhaps rather the strings of them. Now the long-bow (when unstrung) may be most conveniently covered, so as to prevent the rain's injuring it; nor is there scarcely any addition to the weight from such a cause; whereas the arbalest is of a most inconvenient form to be sheltered from the weather. As therefore, in the year 1342, orders issued to the sherives of each county to provide 500 bows, with a proper porportion of arrows, it seems probable that these were long-bows, and not the arbalest.

At the above-mentioned battle, the English ascribed their victory chiefly to the archers.—The battle of Poicters was fought A. D. 1356, and gained by the same means.

Sometimes the archers gained great victories without even the least assistance from the men-at-arms; as, parti-

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particularly, the decisive victory over the Scots at Homildon, A. D. 1402. In that bloody battle, the men-at-arms did not strike a stroke, but were mere spectators of the valour and victory of the archers. The Earl of Douglas, who commanded the Scotch army in that action, enraged to see his men falling thick around him by showers of arrows, and trusting to the goodness of his armour (which had been three years in making) accompanied by about eighty lords, knights, and gentlemen, in complete armour, rushed forward, and attacked the English archers sword in hand. But he soon had reason to repent his rashness. The English arrows were so sharp and strong, and discharged with so much force, that no armour could repell them. The Earl of Douglas, after receiving five wounds, was made prisoner; and all his brave companions were either killed or taken. Philip de Comines acknowledges, what the English writers assert, that their archers excelled those of every other nation; and Sir John Fortescue says again and again,—"that the might of the realme of England standyth upon archers." The superior dexterity of their archers gave the English a great advantage over their capital enemies the French and Scots. The French depended chiefly on their men-at-arms, and the Scots on their pikemen; but the ranks of both were often thinned and thrown into disorder by flights of arrows before they could reach their enemies.

Henry's Hist. vol. v. p. 463.

James I. of Scotland, who had seen and admired the dexterity of the English archers, and who was himself an excellent archer, endeavoured to revive the exercise of archery among his own subjects, by whom it had been too much neglected. With this view, he ridiculed their awkward manner of handling their bows, in his humorous poem of Christ's Kirk on the Green; and procured the following law to be made in his first parliament, A. D. 1424, immediately after his return to Scotland: "That all men might busk thame to be archares fra the be 12 years of age; and that at ilk ten punds worth of land thair be made bow markes, and speciallie near paroche kirks, quhairn upon halie dayis men may cum, and at the leist schuite thryse about, and have usage of archarie: and whasa usis not archarie, the laird of the land sall rais of him a wedder; and giff the laird raisis not the said pane, the king's sherif or his ministers sall rais it to the king." But the untimely death of that excellent prince prevented the effectual execution of this law.

There is not found any act of Parliament of Henry V. in relation to archery, and all the orders in Rymer till the battle of Agincourt relate to great guns, from which he seems at first to have expected more considerable advantage than from the training of bowmen. It should seem, however, that this sort of artillery, from its unwieldiness, bad and narrow roads, together with other defects, was as yet but of little use in military operations. In the year 1417 this king therefore ascribes his victory at Agincourt to the archers, and directs the sherives of many counties to pluck from every goose six wing-feathers for the purpose of improving arrows, which are to be paid for by the king.

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In 1421, though the French had been defeated both at Cressy, Poicters, and Agincourt, by the English archers, yet they still continued the use of the cross-bow; for which reason, Henry V. as duke of Normandy, confirms the charters and privileges of the balistarii, which had been long established as a fraternity in his city of Rouen.

In the fifth year of Edward IV. an act passed, that every Englishman, and Irishman dwelling with Englishmen, shall have an English bow of his own height, which is directed to be made of yew, wych, hazel, ash, or awburne, or any other reasonable tree according to their power. The next chapter also directs that butts shall be made in every township, which the inhabitants are obliged to shoot up and down every feast-day, under the penalty of a halfpenny when they shall omit this exercise.

In the 14th year, however, of this same king, it appears by Rymer's Fœdera, that 1000 archers were to be sent to the duke of Burgundy, whose pay is settled at six pence a-day, which is more than a common soldier receives clear in the present times, when provisions are so much dearer, and the value of money so much decreased. This circumstance seems to prove, very strongly, the great estimation in which archers were still held. In the same year, Edward preparing for a war with France, directs the sherives to procure bows and arrows, "as most specially requisite and necessary."

On the war taking place with Scotland, eight years after this, Edward provides both ordnance and archers; so that though the use of *artillery* (as we now term it) was then gaining ground, yet that of the bow and arrow was not neglected.

Richard III. by his attention to archery, was able to send 1000 bowmen to the duke of Bretagne, and he availed himself of the same troops at the battle of Bosworth.

During the reign of Henry VII. however, there appears no order relative to gun-powder or artillery; whilst, on the other hand, in 1488, he directs a large levy of archers to be sent to Britanny, and that they shall be reviewed before they embark. In the 19th year of his reign, this same king forbids the use of the cross-bow, because "the long-bow had been much used in this realm, whereby honour and victory had been gotten against outward enemies, the realm greatly defended, and much more the dread of all Christian princes by reason of the same."

During the reign of Henry VIII. several statutes were made for the promotion of archery. The 8th Eliz. c. 10. regulates the price of bows, and the 13th Eliz. c. 14. enacts, that bow-staves shall be brought into the realm from the Hanse-towns and the Eastward; so that archery still continued to be an object of attention in the legislature.

In Rymer's *Fœdera* there is neither statute nor proclamation of James I. on this head; but it appears by Dr Birch's Life of his son (prince Henry), that at eight years of age, he learned to shoot both with the bow and gun, whilst at the same time this prince had in his establishment an officer who was styled *bow-bearer*. The king granted a second charter to the artillery company, by which the powers they had received from Henry VIII. were considerably extended.

Charles I. appears from the dedication of a treatise

tise intitled, *The Bowman's Glory*, to have been himself an archer; and in the eighth year of his reign he issued a commission to the chancellor, lord-mayor, and several of the privy council, to prevent the fields near London being so inclosed as "to interrupt the necessary and profitable exercise of shooting," as also to lower the mounds where they prevented the view from one mark to another.

Catharine of Portugal (queen to Charles II.) seems to have been much pleased with the sight at least of this exercise; for in 1676, by the contributions of Sir Edward Hungerford and others, a silver badge for the marshal of the fraternity was made, weighing 25 ounces, and representing an archer drawing the long-bow (in the proper manner) to his ear, with the following inscription: *Reginæ Catherinæ Sagittarii.* The supporters are two bowmen, with the arms of England and Portugal. In 1682 there was a most magnificent cavalcade and entertainment given by the Finsbury archers, when they bestowed the titles of "duke of Shoreditch," "marquis of Islington," &c. upon the most deserving. Charles II. was present upon this occasion; but the day being rainy, he was obliged soon to leave the field.

So lately as the year 1753 targets were erected in the Finsbury fields, during the Easter and Whitsun holidays; when the best shooter was styled Captain for the ensuing year, and the second Lieutenant.

Why this military weapon was so decisive in the battles of former days, the following reasons may be suggested.

Before the introduction of fire-arms, the enemy could only be struck at a distance by slings, the bow used by the ancients, or the cross-bow; to all which the English long-bow was infinitely superior. As for slings, they never have been used in the more northern parts of Europe by armies in the field; nor does their use indeed seem to have been at all convenient or extensively practicable, for two principal reasons; In the first place, slingers cannot advance in a compact body, on account of the space to be occupied by this weapon in its rotatory motion; in the next place, the weight of the stones to be carried must necessarily impede the slingers greatly in their movements. The bow of the ancients, again, as represented in all their reliefs, was a mere toy compared with that of our ancestors; it was therefore chiefly used by the Parthians, whose attacks (like those of the present Arabs) were desultory. As for the cross-bow, it is of a most inconvenient form for carriage, even with the modern improvements; and, in case of rain, could not be easily secured from the weather. After the first shot, moreover, it could not be recharged under a considerable time, whilst the bolts were also heavy and cumbersome. The English long-bow, on the other hand, together with the quiver of arrows, was easily carried by the archer, as easily secured from rain, and recharged almost instantaneously. It is not therefore extraordinary, that troops, who solely used this most effectual weapon, should generally obtain the victory, even when opposed to much more numerous armies.

It may be urged, that these losses having been experienced by our enemies, must have induced them to practise the same mode of warfare.—But it is thought that the long bow was not commonly used even in England till the time of Edward III. when the victory at Cressy sufficiently proclaimed the superiority of that weapon. It required, however, so much training before the archer could be expert, that we must not be surprised if soon afterwards this military exercise was much neglected, as appears by the preambles of several ancient statutes. Whilst the military tenures subsisted, the sovereign could only call upon his tenants during war, who therefore attended with the weapons they had been used to, and which required no previous practice. On the other hand, the English archers were obliged by acts of parliament, even in time of peace, to erect butts in every parish, and to shoot on every Sunday and holiday, after repairing perhaps to these butts from a considerable distance, whilst the expence of at least a yew-bow is represented as being a charge which they were scarcely equal to. The king and parliaments of this country having thus compelled the inhabitants to such training, the English armies had (it should seem) the same advantage over their enemies as the exclusive use of fire-arms would give at present.

It appears also by what hath been already stated, that the long-bow continued to be in estimation for more than two centuries after gunpowder was introduced, which probably arose from muskets being very cumbersome and unwieldy. It is well known that rapid movements are generally decisive of the campaign; and for such the archers were particularly adapted, because, as they could not be annoyed at the same distance by the weapons of the enemy, they had scarcely any occasion for armour. The flower of ancient armies likewise was the cavalry, against which the long-bow never failed to prevail, as man and horse were too large objects to be missed: and hence the great number of French nobility who were prisoners at Cressy, Poicters, and Agincourt; for being dismounted (if not wounded) whilst they were also clad in heavy armour, they could not make their escape. The same reason accounts for the English obtaining these signal victories with so inferior numbers; for the nobility and gentry thus becoming prisoners, the other parts of the French army made little or no resistance. No wonder, therefore, that in England the greatest anxiety was shewn to promote the exercise of this most important weapon, and that so many statutes were made for that purpose.

In Scotland, also, little less attention, though apparently not with equal success, was shewn to the encouragement of the art. In both kingdoms, it was provided, that the importers of merchandise should be obliged, along with their articles of commerce, to import a certain proportion of bows, bow-staves, and shafts for arrows. In both, every person was enjoined to hold himself provided in bows and arrows, and was prescribed the frequent use of archery. In both, a restraint was imposed upon the exercise of other games and sports, lest they should interfere with the use of the bow; for it was intended, that the people should be made expert in the use of it as a military weapon, by habituating them to the familiar exercise of it as an instrument of amusement. As there was no material difference between the activity and bodily strength of the

the two people, it might be ſuppoſed that the Engliſh and Scots wielded the bow with no unequal vigour and dexterity; but from undoubted hiſtorical monuments it appears that the former had the ſuperiority; of which one inſtance has already been narrated. By the regulations preſcribed in their ſtatute-book for the practice of archery, we find that the Engliſh ſhot a very long bow, thoſe who were arrived at their full growth and maturity being prohibited from ſhooting at any mark that was not diſtant upwards of 220 yards.

In the uſe of the bow, great dexterity as well as ſtrength ſeems to have been requiſite. Though we hear of arrows at Cheviot Chaſe which were a yard long, yet it is by no means to be ſuppoſed that the whole band made uſe of ſuch, or could draw them to the head. The regulation of the Iriſh ſtatute of Edward IV. viz. that the bow ſhall not exceed the height of the man, is allowed by archers to have been well conſidered; and as the arrow ſhould be half the length of the bow, this would give an arrow of a yard in length to thoſe only who were ſix feet high. A ſtrong man of this ſize in the preſent time cannot eaſily draw above 27 inches if the bow is of a proper ſtrength to do execution at a conſiderable diſtance. At the ſame time it muſt be admitted, that as our anceſtors were obliged by ſome of the old ſtatutes to begin ſhooting with the long-bow at the age of ſeven, they might have acquired a greater ſlight in this exerciſe than their deſcendants, though the latter ſhould be allowed to be of equal ſtrength.

As the ſhooting of the long-bow was firſt introduced in England, and practiſed almoſt excluſively for nearly two centuries, ſo it hath occaſioned a peculiar method of drawing the arrow to the ear and not to the breaſt. That this is contrary to the uſage of the ancients is very clear from their reliefs, and from the tradition of the Amazons cutting off one of their paps, as it occaſioned an impediment to their ſhooting. The Finſbury archer is therefore repreſented in this attitude of drawing to the ear, both in the *Bowman's Glory*, and in the ſilver badge given by Catharine to the Artillery company. Not many years ago there was a man named Topham, who exhibited ſurpriſing feats of ſtrength, and who happened to be at a public-houſe near Iſlington, to which the Finſbury archers reſorted after their exerciſe. Topham conſidered the long bow as a play-thing, only fit for a child; upon which one of the archers laid him a bowl of punch, that he could not draw the arrow two-thirds of its length. Topham accepted this bet with the greateſt confidence of winning: but bringing the arrow to his breaſt inſtead of his ear, he was greatly mortified by paying the wager, after many fruitleſs efforts.

As to the diſtance to which an arrow can be ſhot from a long-bow with the beſt elevation of forty-five degrees, that muſt neceſſarily depend much both upon the ſtrength and ſlight of the archer; but in general the diſtance was reckoned from eleven to twelve ſcore yards. The butts for exerciſe, as above-noticed, were directed to be diſtant upwards of 220 yards. There is indeed a tradition, that an attorney of Wigan in Lancaſhire (named Leigh) ſhot a mile in three flights; but the ſame tradition ſtates, that he placed himſelf in a very particular attitude, which cannot be uſed commonly in this exerciſe. According to Neade, an archer might ſhoot ſix arrows in the time of charging and diſcharging one muſket.

The archers conſider an arrow of from 20 to 24 drop weight to be the beſt for flight or hitting a mark at a conſiderable diſtance, and that yew is the beſt material of which they can be made. As to the feathers, that of a gooſe is preferred; it is alſo wiſhed, that the bird ſhould be two or three years old, and that the feather may drop of itſelf. Two out of three feathers in an arrow are commonly white, being plucked from the gander; but the third is generally brown or grey, being taken from the gooſe; and, from this difference in point of colour, informs the archer when the arrow is properly placed. From this moſt diſtinguiſhed part therefore the whole arrow ſometimes receives its name: And this, by-the-by, affords an explanation of the grey gooſe wing in the ballad of Cheviot Chaſe. Arrows were armed anciently with flint or metal heads, latterly with heads of iron; of theſe there were various forms and denominations. By an act of parliament, made the 7th of Henry IV. it was enacted, that for the future all the heads for arrows and quarrels ſhould be well boiled or braſed, and hardened at the points with ſteel; and that every arrow-head or quarrel ſhould have the mark of the maker: workmen diſobeying this order, were to be fined and impriſoned at the king's will, and the arrow-heads or quarrels to be forfeited to the crown.

Groſe on Ancient Armour.

Arrows were reckoned by ſheaves, a ſheaf conſiſting of 24 arrows. They were carried in a quiver, called alſo an *arrow-caſe*, which ſerved for the magazine; arrows for immediate uſe were worn in the girdle. In ancient times phials of quicklime, or other combuſtible matter, for burning houſes or ſhips, was fixed on the heads of arrows, and ſhot from long-bows. This has been alſo practiſed ſince the uſe of gunpowder. Neade ſays, he has known by experience, that an archer may ſhoot an ounce of fire-work upon an arrow twelve ſcore yards. Arrows with wild-fire, and arrows for fire-works, are mentioned among the ſtores at Newhaven and Berwick, in the 1ſt of Edward VI.

The force with which an arrow ſtrikes an object at a moderate diſtance, may be conceived from the account given by king Edward VI. in his journal, wherein he ſays, that 100 archers of his guard ſhot before him two arrows each, and afterwards all together; and that they ſhot at an inch board, which ſome pierced quite thro', and ſtruck into the other board; divers pierced it quite through with the heads of their arrows, the boards being well-ſeaſoned timber: their diſtance from the mark is not mentioned.

To protect our archers from the attacks of the enemy's horſe, they carried long ſtakes pointed at both ends: theſe they planted in the earth, ſloping before them. In the 1ſt of Edward VI. 350 of theſe were in the ſtores of the town of Berwick, under the article of archer's ſtakes; there were alſo at the ſame time eight bundles of archer's ſtakes in Pontefract caſtle.

To prevent the bow-ſtring from ſtriking the left arm, the arm is covered with a piece of ſmooth leather, faſtened

Archery. fastened on the outside of the arm: this is called a *bracer*; and to guard the fingers from being cut by the bow-string, archers wore shooting gloves. Chaucer in his prologue to the Canterbury tales, thus describes an archer of his day:

And he was clad in cote and hode of grene,
A shefe of peacock arwes bright and keen,
Under his belt he bare ful thriftily;
Wel coude he dresse his takel yewmanly,
His arwes drouped not with fetheres lowe,
And in his hand he bare a mighty bowe,
A not-hed hadde he, with broune visage,
Of wood crafte coude he wel all the usage;
Upon his arms he had a gai bracer,
And by his side a swerd and a bokeler,
And on the other side a gaie daggere
Harneised wel, and sharp as pointe of spere:
A cristofre on his breast of silver shene,
An horn he bare, the baudrik was of grene,
A forester was he sothely as I gesse.

Though archery continued to be encouraged by the king and legislature for more than two centuries after the first knowledge of the effects of gunpowder, yet by the latter end of the reign of Henry VIII. it seems to have been partly considered as a pastime. Arthur, the elder brother of Henry, is said to have been fond of this exercise, in so much that a good shooter was styled Prince Arthur. We are also informed, that he pitched his tent at Mile End in order to be present at this recreation, and that Henry his brother also attended. When the latter afterwards became king, he gave a prize at Windsor to those who should excel in this exercise; and a capital shot having been made, Henry said to Barlow (one of his guards), "If you still win, you shall be duke over all archers." Barlow therefore having succeeded, and living in Shoreditch, was created duke thereof. Upon another occasion, Henry and the queen were met by 200 archers on Shooter's hill, which probably took its name from their assembling near it to shoot at marks. This king likewise gave the first charter to the Artillery Company in the 29th year of his reign, by which they are permitted to wear dresses of any colour except purple and scarlet, to shoot not only at marks but birds, if not pheasants or herons, and within two miles of the royal palaces. They are also enjoined by the same charter not to wear furs of a greater price than those of the martin. The most material privilege, however, is, that of indemnification from murder, if any person passing between the shooter and the mark is killed, provided the archers have first called out *fast*.

The following description of an archer, his bow and accoutrements, is given in a MS. written in the time of Queen Elizabeth. "Captains and officers should be skilful of that most noble weapon, and to see that their soldiers according to their draught and strength have good bows, well nocked, well strynged, everie strynge whippe in their nocke, and in the myddes rubbed with wax, braser and shuting glove, some spare strynges trymed as aforesaid, every man one shefe of arrows, with a case of leather defensible against the rayne, and in the same fower and twentie arrowes, whereof eight of them should be lighter than the residue, to gall or astoyne the enemye with the hailshot of light arrows, before they shall come within the danger of their harquebuss shot. Let every man have a brigandine, or a little cote of plate, a skull or hufkyn, a mawle of leade of five foot in lengthe, and a pike, and the same hanging by his girdle, with hook and a dagger; being thus furnished, teach them by musters to march, shoote, and retire, keeping their faces upon the enemy's. Sumtyme put them into great nowmbers, as to battell apparteyneth, and thus use them often times practised, till they be perfecte; ffor those men in battell ne skirmish can not be spared. None other weapon maye compare with the same noble weapon."

The long-bow, as already observed, maintained its place in the armies long after the invention of fire-arms. Nor have there been wanting experienced soldiers who were advocates for its continuance, and who in many cases even preferred it to the harquebuss or musket. King Charles I. twice granted special commissions under the great seal for enforcing the use of the long bow. The first was in the 4th year of his reign: but this was revoked by proclamation four years afterwards, on account of divers extortions and abuses committed under sanction thereof. The second, anno 1633, in the 9th year of his reign, to William Neade and his son, also named William, wherein the former is styled an ancient archer, who had presented to the king a warlike invention for uniting the use of the pike and bow, seen and approved by him and his council of war: wherefore his Majesty had granted them a commission to teach and exercise his loving subjects in the said invention, which he particularly recommended the chief officers of his trained bands to learn and practise; and the justices and other chief magistrates throughout England, are therein enjoined to use every means in their power to assist Neade, his son, and all persons authorised by them in the furtherance, propagation, and practice of this useful invention. Both the commissions and proclamation are printed at large in Rymer. At the breaking out of the civil war, the Earl of Essex issued a precept, dated in November 1643, for stirring up all well-affected people by benevolence, towards the raising a company of archers for the service of the king and parliament.

Archery with the long-bow continues to be used as a manly exercise by the inhabitants of Geneva, and in many parts of Flanders; nor is it totally neglected in Great Britain. There are several societies of archers in England; the chief of which are, *Woodmen of Arden*, and the *Toxophilite*. But the most noted society of this kind, now existing, is

The *Royal Company of Archers* in Scotland.—The ancient records of this company having been destroyed by fire about the beginning of the present century, no authentic traces of their institution now remain. It is said that they owe their origin to the commissioners appointed in the reign of James I. of Scotland for enforcing and overseeing the exercise of archery in different counties. Those commissioners, who were in general men of rank and power, picking out amongst the better sort of people under their cognisance the most expert archers, formed them into a company, and upon perilous

rilous occaſions made a preſent of their ſervices to the king as his chief body-guards; in which ſituation they often diſtinguiſhed themſelves for their loyalty, their courage, and ſkill in archery. This rank of the king's principal body-guards the Royal Company ſtill claim within ſeven miles of the metropolis of Scotland.

Certain it is, that by an act of the privy-council of Scotland in the 1677, this Company was recogniſed under the name and title of "His Majeſty's Company of Archers:" And by the ſame act a piece of plate of the value of L. 20 Sterling was ordered to be given to be ſhot for by them at their annual parades called *WEAPON-ſhawings*, and to be called *The King's Prize*.

At this period the Royal Company conſiſted, as it does at preſent, of the principal nobility and gentry of Scotland. But their unfortunate attachment to anti-revolution principles, upon that event's taking place, put almoſt a period to their exiſtence: Their public parades or marches were diſcontinued, and the royal prize was with-held.

Upon the acceſſion of Queen Anne, their former ſplendor was revived; and in the year 1703 they obtained a royal charter, confirming in general terms all their former rights and privileges, and conferring others upon them. But their partiality to the family of Stuart was at various after periods the cauſe of a temporary proſperity and decline.

Theſe unhappy differences of opinion having totally ſubſided, the Royal Company are now more numerous and flouriſhing than ever, and perhaps even more dexterous archers. His preſent Majeſty, as a mark of his royal patronage and approbation, has been pleaſed to revive the royal prize, which for the firſt time was ſhot for upon the 28th of July 1788 by a numerous and reſpectable meeting.

The Woodmen of Arden and the Toxophilite have lately been pleaſed to admit the members of the Royal Company to the freedom of their ſocieties: theſe grants have been followed by reciprocal diplomas from the Royal Company; ſo that the three chief ſocieties of archers in Britain may be ſaid to be now incorporated into one.

The prizes belonging to this Company, and which are annually ſhot for, are, 1. A ſilver arrow, given by the town of Muſſelburgh, which appears to have been ſhot for as early as the year 1603. The victor in this, as in the other prizes, except the king's prize, has the cuſtody of it for a year, then returns it with a medal appended, on which are engraved any motto and device which the gainer's fancy dictates. 2. A ſilver arrow given by the town of Peebles A. D. 1626. 3. A ſilver arrow given by the city of Edinburgh A. D. 1709. 4. A ſilver punch-bowl of about the value of L. 50, made of Scottiſh ſilver at the expence of the Company, A. D. 1720. And, 5. The king's prize above mentioned, which becomes the abſolute property of the winner. All theſe prizes are ſhot for at what is termed *rovers*, the marks being placed at the diſtance of 185 yards.

Beſides theſe, there is another prize annually contended for at butt or point-blank diſtance, called the *Gooſe*. The ancient manner of ſhooting for this prize was, a living gooſe was built in a turf-butt, having the head only expoſed to view; and the archer who firſt hit the gooſe's head was intitled to the gooſe as his reward. But this cuſtom, on account of its barbarity, has been long ago laid aſide; and in place of the gooſe-head, a mark of about an inch diameter is affixed upon each butt, and the archer who firſt hits this mark is captain of the butt-ſhooters for a year.

The affairs of the Company are managed by a preſes and ſix counſellers, who are choſen annually by the whole members. The council are veſted with the power of receiving or rejecting candidates for admiſſion, and of appointing the company's officers civil and military.

The Royal Company now conſiſts of above 1000 members, among whom are moſt of the Scottiſh nobility of the firſt diſtinction. A number of the Company meet weekly during the ſummer-ſeaſon in Edinburgh, in the Meadows, where they exerciſe themſelves in ſhooting at butts or rovers: And in the adjoining ground they have a handſome building, erected within theſe 12 years, whith ſuitable offices, whither they adjourn after their exerciſe, and where they hold their elections and other meetings relative to the buſineſs of the ſociety.

The uniform of the Royal Company of Archers is tartan, lined with white, and trimmed with green and white fringes; a white ſaſh, with green toſſels; and a blue bonnet, with a St Andrew's croſs and feathers. The Company have two ſtandards. The firſt of theſe bears on one ſide Mars and Cupid encircled in a wreath of thiſtles; with this motto, "*In peace* and war." On the other, a yew tree, with two men dreſſed and equipped as archers, encircled as the former; motto, *Dat gloria vires*. The other ſtandard diſplays, on one ſide, a lion rampant gules, on a field or, encircled with a wreath; on the top, a thiſtle and crown; motto, *Nemo me impune laceſſet*. On the other, St Andrew on the croſs on a field argent; at the top, a crown; motto, *Dulce pro patria periculum*.

ARCHES-COURT, in Engliſh eccleſiaſtical polity, is a court of appeal, belonging to the archbiſhop of each province; whereof the judge is called the *dean of the arches*, becauſe he anciently held his court in the church of St Mary *le bow* (*Sancta Maria de arcubus*), though all the principal ſpiritual courts are now holden at Doctors Commons. His proper juriſdiction is only over the 13 peculiar pariſhes belonging to the archbiſhop in London; but the office of dean of the arches having been for a long time united with that of the archbiſhop's principal office, he now, in right of the laſt-mentioned office, receives and determines appeals from the ſentences of all inferior eccleſiaſtical courts within the province. And from him there lies an appeal to the king in chancery (that is, to a court of delegates appointed under the king's great ſeal), by ſtatute 25 Hen. VIII. c. 19. as ſupreme head of the Engliſh church, in the place of the biſhop of Rome, who formerly exerciſed this juriſdiction; which circumſtance alone will furniſh the reaſon why the Popiſh clergy were ſo anxious to ſeparate the ſpiritual court from the temporal.

ARCHETYPE, the firſt model of a work, which is copied after to make another like it.—Among minters, it is uſed for the ſtandard weight by which the o-

thers

thers are adjuſted.—The archetypal world, among Platoniſts, means the world as it exiſted in the idea of God before the viſible creation.

ARCHEUS, (from αρχη, the principal, chief, or firſt mover); a ſort of primum mobile ſet up by Helmont, to ſuperintend the animal œconomy, and preſerve it. It is akin to Plato's *anima mundi*—Hippocrates uſes the word αρχαιη φυσις, to ſignify the former healthy ſtate before the attack of the diſeaſe.

ARCHIACOLYTHUS (from αρχος, *chief*, and ακολουθος, *miniſter*), an ancient dignity in cathedral churches: the miniſters whereof were divided into four orders or degrees, viz. prieſts, deacons, ſubdeacons, and acolythi; each of which had their chiefs. The chief of the acolythi was called *archiacolythus*.

ARCHIATER, Archiatrus, properly denotes chief phyſician of a prince who retains ſeveral. The word is formed of αρχη, *principium*, "chief;" and ιατρος, *medicus*, a "phyſician."

ARCHIDAPIFER, (from αρχος, and *dapifer*, "ſewer,") or chief ſewer, is a great officer of the empire. The elector of Bavaria is archidapifer. The palatine of the Rhine, at one time pretended this office was annexed to his palatinate; but he has ſince deſiſted.

ARCHIEROSYNES, in the Grecian antiquity, a high prieſt veſted with authority over the reſt of the prieſts, and appointed to execute the more ſacred and myſterious rites of religion.

ARCHIGALLUS, in antiquity, the high-prieſt of Cybele, or the chief of the eunuch-prieſts of that goddeſs, called *Galli*.

ARCHIGERONTES (from αρχος, and γερων *old*), in antiquity, the chiefs or maſters of the ſeveral companies of artificers at Alexandria. Some have miſtaken the archigerontes for the arch-prieſts appointed to take the confeſſions of thoſe who were condemned to the mines.

ARCHIGUBERNUS, Archiguberneta, or Archigubernites, in antiquity, the commander of the imperial ſhip, or that which the emperor was aboard of. Some have confounded the office of archigubernus with that of *præfectus claſſis*, or admiral, but the former was under the command of the latter. Potter takes the proper office of the archiguberneta to have been, to manage the marine affairs, to provide commodious harbours, and order all things relating to the ſailing of the fleet, except what related to war.

ARCHIL, Archilla, Rocella, Orsielle, is a whitiſh moſs which grows upon rocks, in the Canary and Cape Verd iſlands, and yields a rich purple tincture, fugitive indeed, but extremely beautiful. This weed is imported to us as it is gathered. Thoſe who prepare it for the uſe of the dyer, grind it betwixt ſtones, ſo as to thoroughly bruiſe, but not to reduce it into powder; and then moiſten it occaſionally with a ſtrong ſpirit of urine, or urine itſelf mixed with quicklime: in a few days it acquires a purpliſh red, and at length a blue colour. In the firſt ſtate it is called *Archil;* in the latter, *Lacmus* or *Litmaſe*.

The dyers rarely employ this drug by itſelf, on account of its dearneſs and the periſhableneſs of its beauty. The chief uſe they make of it is, for giving a bloom to other colours, as pinks, &c. This is effected by paſſing the dyed cloth or ſilk through hot water lightly impregnated with the archil. The bloom thus communicated ſoon decays upon expoſure to the air. Mr Hellet informs us, that by the addition of a little ſolution of tin, this drug gives a durable dye; that its colour is at the ſame time changed towards a ſcarlet; and that it is the more permanent in proportion as it recedes the more from its natural colour.

Prepared archil very readily gives out its colour to water, to volatile ſpirits, and to ſpirit of wine; it is the ſubſtance principally made uſe of for colouring the ſpirits of thermometers. As expoſure to the air deſtroys its colour upon cloth, the excluſion of the air produces a like effect in theſe hermetically ſealed tubes, the ſpirits of large thermometers becoming in the compaſs of a few years colourleſs. M. l'Abbe Nollet obſerves (in the French Memoirs for the year 1742), that the colourleſs ſpirit, upon breaking the tube, ſoon reſumes its colour, and this for a number of times ſucceſſively; that a watery tincture of archil, included in the tubes or thermometers, loſt its colour in three days; and that, in an open deep veſſel, it became colourleſs at the bottom, while the upper part retained its colour. See *Colour-Making*, nº 38.

A ſolution of archil in water, applied on cold marble, ſtains it of a beautiful violet, or purpliſh blue colour, far more durable than the colour which it communicates to other bodies. Mr du Fay ſays he has ſeen pieces of marble ſtained with it, which in two years had ſuffered no ſenſible change. It ſinks deep into the marble, ſometimes above an inch; and at the ſame time ſpreads upon the ſurfaee, unleſs the edges be bounded by wax or other like ſubſtances. It ſeems to make the marble ſomewhat more brittle.

Linnæus informs us, in the Swediſh Tranſactions for the year 1742, that the true archil moſs is to be found on the weſtern coaſts of England. It has been for a conſiderable time paſt prepared by Meſſrs Gordons at Leith from a ſpecies found in the Highlands of Scotland.

ARCHILOCHIAN, a term in poetry, applied to a ſort of verſes, of which Archilochus was the inventor, conſiſting of ſeven feet; the four firſt whereof are ordinarily dactyls, though ſometimes ſpondees; the three laſt trochees, as in Horace,

Solvitur acris hyems, grata vice veris & Favoni.

ARCHILOCHUS, a famous Greek poet and muſician, was, according to Herodotus, contemporary with Candaules and Gyges, kings of Lydia, who flouriſhed about the 14th Olympiad, 724 years before Chriſt. But he is placed much later by modern chronologiſts; viz, by Blair, 686, and by Prieſtley 660 years, before Chriſt.

He was born at Paros, one of the Cyclades. His father Teleſicles was of ſo high a rank, that he was choſen by his countrymen to conſult the oracle at Delphos concerning the ſending a colony to Thaſos: a proof that he was of one of the moſt diſtinguiſhed families upon the iſland. However, he is ſaid to have ſullied his birth by an ignoble marriage with a ſlave called *Enipo*, of which alliance our poet-muſician was the fruit.

Though Archilochus ſhowed an early genius and attachment to poetry and muſic, theſe arts did not prevent

vent his going into the army, like other young men of his birth; but in the first engagement at which he was present, the young poet, like Horace, and like our own Suckling, lost his buckler, though he saved his life by the help of his heels. *It is much easier*, said he, *to get a new buckler than a new existence.* This pleasantry, however, did not save his reputation: nor could his poetry or prayers prevail upon Lycambes, the father of his mistress, to let him marry his daughter, though she had been long promised to him. After these mortifications, his life seems to have been one continued tissue of disgrace and resentment,

Archilochum proprio rabies armavit iambo.
HOR. Art. Poet. 79.

Archilochus, with fierce resentment warm'd,
Was with his own severe iambics arm'd. FRANCIS.

The *rage of Archilochus* was proverbial in antiquity; which compared the provoking this satirist to the treading upon a serpent: A comparison not very severe, if it be true that Lycambes, and, as some say, his three daughters, were so mortified by his satire, as to be driven to the consolation of a halter.

In this piece, many adventures are mentioned, full of defamation, and out of the knowledge of the public. There were likewise many loose passages in it; and it is said to have been on account of this satire that the Lacedemonians laid a prohibition on his verses*.

* Val. Max. lib. 6. c. 3.

However, according to Plutarch, there is no bard of antiquity by whom the two arts of poetry and music have been so much advanced as by Archilochus. To him is attributed particularly the sudden transition from one rhythm to another of a different kind, and the manner of accompanying those irregular measures upon the lyre. Heroic poetry, in hexameter verse, seems to have been solely in use among the more ancient poets and musicians; and the transition from one rhythm to another, which lyric poetry required, was unknown to them; so that if Archilochus was the first author of this mixture, he might with propriety be styled the *Inventor of Lyric Poetry*, which, after his time, became a species of versification wholly distinct from heroic.— To him is likewise ascribed the invention of *Epodes.* See EPODE.

Our poet-musician is generally ranked among the first victors of the Pythic games: and we learn from Pindar, that his muse was not always a termagant; for though no mortal escaped her rage, yet she was at times sufficiently tranquil and pious to dictate hymns in praise of the gods and heroes. One in particular, written in honour of Hercules, acquired him the acclamations of all Greece; for he sung it in full assembly at the Olympic games, and had the satisfaction of receiving from the judges the crown of victory consecrated to real merit. This hymn, or ode, was afterwards sung in honour of every victor at Olympia, who had no poet to celebrate his particular exploits.

Archilochus was at last slain by one Callondax Corax, of the island of Naxos; who, though he did it in fight, according to the laws of war, was driven out of the temple of Delphi, by command of the oracle, for having deprived of life a man consecrated to the Muses.

The names of Homer and Archilochus were equally revered and celebrated in Greece, as the two most excellent poets which the nation had ever produced. This appears from an epigram in the Anthologia; and from Cicero, who ranks him with poets of the first class, and in his Epistles tells us, that the grammarian Aristophanes, the most rigid and scrupulous critic of his time, used to say, that the longest poem of Archilochus always appeared to him the most excellent.

ARCHIMAGUS, the high-priest of the Persian Magi or worshippers of fire. He resided in the highest fire-temple; which was had in the same veneration with them as the temple of Mecca among the Mahometans. Zoroastres first settled it at Balch; but after the Mahometans had over-run Persia in the 7th century, the Archimagus was forced to remove from thence into Kerman, a province of Persia, lying on the southern ocean, where it hath continued to this day. Darius Hystaspes took upon himself the dignity of Archimagus: for Porphyry tells us, he ordered before his death, that, among the other titles, it should be engraven on his monument, that he had been *Master of the Magi;* which plainly implies that he had borne this office among them, for none but the Archimagus was master of the whole sect. From hence it seems to have proceeded, that the kings of Persia were ever after looked on to be of the sacerdotal tribe, and were always initiated into the sacred order of the Magi, before they took on them the crown, and were inaugurated in the the kingdom.

ARCHIMANDRITE, in ecclesiastical history, was a name given by the ancient Christians to what we now call an *abbot*. Father Simon observes, that the word *mandrite* is Syriac, and signifies a solitary monk.

ARCHIMIDES, a celebrated geometrician, born at Syracuse in the island of Sicily, and related to Hiero king of Syracuse. He was remarkable for his extraordinary application to mathematical studies; in which he used to be so much engaged, that his servants were often obliged to take him from thence by force. He had such a surprising invention in mechanics, that he affirmed to Hiero, if he had another earth, whereon to plant his machines, he could move this which we inhabit. He is said to have formed a glass sphere, of a most surprising workmanship, wherein the motions of the heavenly bodies were represented. He discovered the exact quantity of the silver which a goldsmith had mixed with the gold in a crown he had made for the king; he had the hint of this discovery from his perceiving the water rise up the sides of the bath as he went into it, and was filled with such joy, that he ran naked out of the bath, crying, "I have found it! I have found it!" By the invention of machines, he, for a long time, defended Syracuse on its being besieged by Marcellus (See SYRACUSE). On the city's being taken, that general commanded his soldiers to have a particular regard to the safety of this truly great man; but his care was ineffectual. "What gave Marcellus the greatest concern (says Plutarch), was the unhappy Archimedes, who was at that time in his musæum, and his mind, as well as his eyes, so fixed and intent upon some geometrical figures, that he neither heard the noise and hurry of the Romans, nor perceived the city was taken. In this depth of study and contemplation, a soldier came suddenly upon him, and commanded him to follow him to Marcellus; which he refuſing to do till he had finiſhed his problem, the ſoldier, in a rage, drew his ſword, and ran him through the body." Others have related the circumſtances of his death in a ſomewhat different manner. It however happened 208 years before the Chriſtian æra. Cicero, when he was quæſtor in Italy, diſcovered his tomb, on which was carved a cylinder and ſphere†. Some of the works of this great mathematician are loſt, but others are preſerved. His pieces which remain are, 1. Two books of the Sphere and Cylinder. 2. The Dimenſions of a Circle. 3. Of Centers of Gravity, or Æquiponderants. 4. Of Spheroids and Conoids. 5. Of Spiral Lines. 6. The Quadrature of a Parabola. 7. Of the Number of the Sand. 8. Of Bodies that float on Fluids. The beſt edition is theſe is that publiſhed at London, in 1675, 4to. Among the works of Archimedes which are loſt, we may reckon the deſcriptions of the following inventions, which we may gather from himſelf and other ancient authors. 1. Περι της στεφανης, or his account of the method which he uſed to diſcover the mixture of gold and ſilver in the crown. 2. His deſcription of the Κοχλια, or Κοχλιον, an engine to draw water out of places where it is ſtagnated. Athenæus, ſpeaking of the prodigious ſhip built by the order of Hiero, tells us, that Archimedes invented the cochlion, by means of which the hold, notwithſtanding its depth, could be drained by one man. (Δειπνοσοφιςων, lib. b.) Diodorus Siculus informs us (lib. v.) that he contrived this machine to drain Egypt, and that by a wonderful mechaniſm it would empty the water from any depth. 3. The Ελιξ, by means of which (according to Athenæus, Δειπνοσ, lib. v.) he launched Hiero's great ſhip. 4. The Τρισπαστον, of the power of which Tzetzes gives a hyperbolical relation, Chil. ii. hiſt. 35. 5. The machines he uſed in the defence of Syracuſe againſt Marcellus

† *Tuſcul. Quæſt.* l. iv.

Of theſe we have an account in Polybius, Livy, and Plutarch. 6. His burning-glaſſes, with which he is ſaid to have ſet fire to the Roman galleys. Galen, Περι κρασεων, lib. iii. 7. His pneumatic and hydraulic engines, concerning which he wrote books, according to Tzetzes, Chil. ii. hiſt. 35.

ARCHIPELAGO, in geography, a general term ſignifying a ſea interrupted with iſlands; it is however more eſpecially applied to that lying between Europe and Aſia, which contains the iſlands anciently called *Cyclades* and *Sporades*. See theſe two words.

ARCHIPHERACITÆ, miniſters in the Jewiſh ſynagogues appointed to read and interpret the Perakim, or titles and heads of the law and the prophets.

ARCHPRESBYTER, ARCH-PRIEST, a prieſt eſtabliſhed in ſome dioceſes with a ſuperiority over the reſt. He was anciently choſen out of the college of preſbyters at the pleaſure of the biſhop. Theſe archpreſbyters were much of the ſame nature with deans in the cathedral churches, as the college of preſbyters anſwers to the chapter. See PRESBYTER.

ARCHISYNAGOGUS, the chief of the ſynagogue; the title of an officer among the Jews, who preſided in their ſynagogues and aſſemblies. The number of theſe officers was not fixed, nor the ſame in all places: there being 70 in ſome, and in others only one. They are ſometimes called *princes* of the ſynagogue, and had a power of excommunicating ſuch as deſerved that puniſhment.

ARCHITECT, a perſon ſkilled in architecture, or the art of building; who forms plans and deſigns for edifices, conducts the work, and directs the ſeveral artificers employed in it. The word is derived from αρχος, *princeps*, and τεκτων, *faber*, "workman; q. d. the principal workman.

A R C H I T E C T U R E,

IN the utmoſt latitude of the word, ſignifies the art of building in general; but the term is moſt frequently applied only to the conſtruction of ſuch buildings as are neceſſary for the purpoſes of civil life, ſuch as houſes, churches, halls, bridges, porticoes, *&c.*

Hiſtory of Architecture.

THE origin of this art, like that of moſt others, is totally unknown. We are aſſured, however, that it is as old as Cain: for Moſes tells us that he built a city; tho' what were the materials, or how the buildings were conſtructed, we are entirely ignorant. It is commonly ſaid, that the firſt materials employed in building were branches and twigs of trees, wherewith men conſtructed huts, ſuch as the *wigwams* in uſe among the American Indians at preſent. This, however, appears diſputable. The natural ſhelter afforded by hollows in the ſides of mountains or rocks, it may be ſuppoſed, would much more readily ſuggeſt the idea of uſing ſtones and earth as materials for building houſes. Indeed, conſidering that tents were not invented before the days of Jabal, Tubal-Cain's brother, it is very probable that ſuch temporary houſes as the Indian wigwams were not originally known; otherwiſe the method of covering poles with the ſkins of beaſts, inſtead of ſmall branches or twigs, muſt very ſoon have taken place. Theſe temporary houſes ſeem to have come into uſe only when men began to lead an idle wandering life, like the Tartars, and could not be at the trouble of conſtructing durable habitations in every place where they were obliged to wander with their cattle; and Jabal perhaps from them took the hint of making portable houſes or tents. Accordingly we ſee, that no nations, except thoſe who are in a perpetually unſettled ſtate, make uſe of ſuch wretched materials. Even in America, where the human race has appeared in the rudeſt form, they were no ſooner collected into great bodies under the emperors of Mexico and Peru, than ſtone-buildings began to be erected.

1 Materials firſt uſed in building.

We are not, therefore, to look for the origin of architecture in any ſingle nation; but in every nation, when the inhabitants began to leave off their ſavage way of life, and to become civilized; and if there is any nation to be found which hath been always in a civilized ſtate, we may be aſſured that architecture hath always had an exiſtence there. But whatever may be in this, the origin of regular buildings hath been deduced

duced from the construction of the meanest huts in a very natural and plausible manner by several authors. "Anciently (says Vitruvius) men lived in woods, and inhabited caves; but in time, taking perhaps example from birds, who with great industry build their nests, they made themselves huts. At first they made these huts, very probably, of a conic figure; because that is a figure of the simplest structure; and, like the birds, whom they imitated, composed them of branches of trees, spreading them wide at the bottom, and joining them in a point at the top; covering the whole with reeds, leaves, and clay, to screen them from tempests and rain.

2 Primitive huts Plate XXXVI. fig. 1.

3 Their improvement.

"But finding the conic figure inconvenient on account of its inclined sides, they changed both the form and construction of their huts, giving them a cubical figure, and building them in the following manner: Having marked out the space to be occupied by the hut, they fixed in the ground several upright trunks of trees to form the sides, filling the interval between them with branches closely interwoven and covered with clay. The sides being thus completed, four large beams were placed on the upright trunks; which, being well joined at the angles, kept the sides firm, and likewise served to support the covering or roof of the building, composed of many joists, on which were laid several beds of reeds, leaves, and clay.

Plate XXXVI. fig. 2.

"Insensibly mankind improved in the art of building, and invented methods to make their huts lasting and handsome, as well as convenient. They took off the bark, and other unevennesses, from the trunks of trees that formed the sides; raised them, probably, above the dirt and humidity, on stones; and covered each of them with a flat stone or slate, to keep off the rain. The spaces between the ends of the joists were closed with clay, wax, or some other substance; and the ends of the joists covered with thin boards cut in the manner of triglyphs. The position of the roof was likewise altered: for being, on account of its flatness, unfit to throw off the rains that fell in great abundance during the winter season, they raised it in the middle; giving it the form of a gable roof, by placing rafters on the joists, to support the earth and other materials that composed the covering.

Fig. 3.

"From this simple construction the orders of architecture took their rise. For when buildings of wood were set aside, and men began to erect solid and stately edifices of stone, they imitated the parts which necessity had introduced into the primitive huts; in so much that the upright trees, with the stones at each end of them, were the origin of columns, bases, and capitals; and the beams, joists, rafters, and strata of materials that formed the covering, gave birth to architraves, frizes, triglyphs, and cornices, with the corona, the mutules, the modillions, and the dentils.

"The first buildings were in all likelihood rough and uncouth; as the men of those times had neither experience nor tools: but when by long experience and reasoning upon it, the artists had established certain rules, had invented many instruments, and by great practice had acquired a facility in executing their ideas, they made quick advances towards perfection, and at length discovered certain manners of building, which succeeding ages have regarded with the highest veneration."

4 State of architecture among the Egyptians.

Among the ancient Egyptians, Assyrians, and Persians, this art was carried to an incredible length. The pyramids of Egypt are such structures as would exceed the power of the most potent monarch on earth to raise at this day. The largest of these, according to the account of M. Goguet, is near 500 feet high, and contains 313,590 solid fathoms. It is composed of stones enormously large; many of them being 30 feet long, four feet high, and three in breadth; and all this huge mass of building was coated over with square flags of marble—The structure called the *labyrinth*, in the same country, according to Herodotus, who saw it, excelled every thing which he could have conceived from the imagination either of himself or others. Within the same circuit of walls they had inclosed 3000 halls, 12 of which were of a singular form and beauty; and of these, half were above, and half below ground; and the whole was terminated by a pyramid 40 fathoms high. All this prodigious mass of building was composed of white marble, and the walls were adorned with engravings.—The obelisks were not less astonishing; the largest of them being entire pieces of granite, no less than 180 feet high.—Near Andera, in Upper Egypt, are the ruins of a palace of gray granite, the cielings of which are supported by columns of such thickness, that four men can scarcely fathom them. The cielings themselves are composed of stones of the same kind, six or seven feet in breadth and 18 feet in length. The grand hall is 112 feet long, 60 high, and 58 broad. The roof of the whole edifice is a terrace, on which the Arabs formerly built a very large village, the ruins of which are still visible.

5 Among the Babylonians and Persians.

Among the Babylonians and Persians, too, such immense piles of building have been raised, as appear utterly inconceivable, and incredible to many modern authors where their former grandeur is not demonstrable by ruins visible at this day. The ruins of Persepolis, the ancient capital of Persia, were so stupendous in the time of Avicenna the Arab physician, that his countrymen could not believe such structures possible to be erected but by evil spirits. Of their extraordinary magnificence, indeed, we may have some idea from the account of the stair-cases belonging to the palace. The remains, some time ago, consisted of 95 steps of white marble, so broad and flat, that 12 horses might conveniently go up abreast.

6 Their buildings more remarkable for greatness than elegance.

In these vast structures, however, the nations of whom we speak seem to have regarded the greatness, rather than the elegance or usefulness of their works. In the pyramids and obelisks of Egypt this is exceedingly conspicuous; but whether it was so in the labyrinth or in the palace of Thebes above mentioned, it is impossible to determine, unless the buildings were entire, and we knew for what purpose they had been designed. If the kings who built the pyramids designed to immortalize their memories by building, they certainly could not have fallen upon any thing more proper for this purpose; though even in this they have some how or other failed, the names of those who erected them not being certainly known even in the time of Herodotus.—It is certain, however, that neither the ancient Assyrians nor Babylonians knew the method of constructing arches. The roofs of all their halls were flat, and covered with prodigiously large stones, some of them so big as to cover a whole room singly. Their manner of

7 Ignorant of the use of arches.

of building was also quite destitute of what is now called *taste*; the columns were ill-proportioned, and their capitals executed in the poorest manner imaginable. This was observed by the Greeks, who improved upon the proportions formerly used, and were the inventors of three of the five orders of architecture, viz. the Doric, Ionic, and Corinthian.

8
And of proportioning columns.

"Anciently (says Vitruvius) they were ignorant of the art of proportioning the various parts of a building: they used columns; but they cut them at hazard, without rules, without principles, and without having any attention to the proportions which they ought to give them: they placed them likewise without any regard to the other parts of the edifice.

Origin of the Doric order.

Dorus, son of Helen and grandson of Deucalion, having caused a temple to be built at Argos in honour of Juno, that edifice was found by chance to be constructed according to the taste and proportions of the order which afterwards they called *Doric*. The form of this building having appeared agreeable, they conformed to it for the construction of edifices which they afterwards had to build.

"About the same time, the Athenians sent into Asia a colony under the conduct of Ion, nephew of Dorus: this undertaking had very good success. Ion seized on Caria, and there founded many cities: these new inhabitants thought to build temples. They proposed for a model that of Juno at Argos; but, ignorant of the proportion which they ought to give to the columns, and in general to the whole edifice, they sought for rules capable of regulating their operation. These people wanted, in making their columns sufficiently strong to support the whole edifice, to render them at the same time agreeable to the sight. For this purpose, they thought to have given it the same proportion that they found between the foot of a man and the rest of his body. According to their ideas, the foot made a sixth part of the human height: in consequence, they gave at first to a Doric column, taking in its chapiter, six of its diameters; that is to say, they made it six times as high as it was thick: afterwards they added to it a seventh diameter.

10
Of the Ionic

"This new order of architecture was not long in giving birth to a second: they would immediately go beyond their first invention. The Ionians tried to throw still more delicacy and elegance into their edifices. They employed the same method which they had before put in practice for the composition of the Doric order: but instead of taking for a model the body of a man, the Ionians were regulated by that of a woman. With a view to make the columns of this new order more agreeable and more pleasing, they gave them eight times as much height as they had diameter. They also made channelings all along the trunk to imitate the folds of the robes of women: the volutes of the chapiter represented that part of the hair which hung in curls on each side of the face. The Ionians added, lastly, to these colums a base, which was not in use in the Doric order." According to Vitruvius, these bases were made in the manner of twisted cords, as a kind of case for the columns. This order of architecture was called *Ionic*, from the name of the people who had invented it.

Such is the account given by Vitruvius of the origin of improvements in the proportion of columns. Had these improvements, however, existed in such early times, Homer, who was greatly posterior to them, would certainly have made mention of something of that kind; but in all his writings he gives us no account of any thing like columns of stone, but uses a word which would rather incline us to think that his columns were nothing more than bare posts.

11
Hints of improvement probably taken from Solomon's temple.

It is remarkable, that improvements in architecture did not take place in any nation till after, or about, the time that Jerusalem was taken by Nebuchadnezzar. The grandest buildings erected among the Assyrians seem to have owed their existence to this monarch; and it can scarce be imagined that he would not endeavour to imitate the architecture of Solomon's temple, to which, by his conquest of Jerusalem, he had full access.—It is also remarkable, that the dimensions of the two pillars, Jachin and Boaz, set up by Solomon, very nearly correspond with those of the Doric order, first invented by the Greeks, and which originally came from their colonies settled in Asia Minor. The height of Solomon's pillars, without the chapiter, was 18 cubits; that of the chapiter itself was five cubits; the circumference was 12 cubits; from whence, according to the scripture language, we may reckon the diameter to have been exactly four cubits. Had they been a single cubit higher, they would have been precisely of the same height with columns of the original Doric order. We do not indeed mean to assert, that this famous temple gave a model of architecture to the whole world; although it is scarce conceivable but imitations of it, as far as could be known, must have taken place among many nations.

12
Egyptian banqueting room described.

Notwithstanding all their defects, however, the Egyptian buildings undoubtedly have an air of vast grandeur and magnificence, if we may credit the description given of one of their banqueting-rooms by Vitruvius. The usual size of one of these rooms was from 100 to 150 feet in length, and its breadth somewhat more than half its length. At the upper end, and along the two sides, they placed rows of pillars tolerably well proportioned to one another, though not of any regular order; and at the lower part they made a magnificent and spacious entrance; this, with its ornaments, seems to have taken up one end of the building entire. We are not told that there were any pillars there; tho' perhaps they placed two or more towards the angles on each side, for uniformity, the central space being enough for an enrance in the grandest and most august manner. These rows of columns were set at a distance from the wall, forming a noble portico along the two sides and upper end of the building. Upon the pillars was laid an architrave; and from this was carried up a continued wall with three quarter columns, answering directly to those below, and in proportion one-fourth smaller in all their parts. Between these three quarter columns were placed the windows for enlightening the building. From the tops of the lower pillars to the wall was laid a floor: this covered the portico overhead within, and made on the outside a platform, which was surrounded by a corrider with rails and ballusters. This was terraced, and served as a plain for people to walk on; and from this they could look through the windows down into the room. To this terrace there was no covering required, as the Egyptians were in no fear of rain. The Egyptians decorated this sort of building with ſtatues; and no kind of ornament could anſwer it ſo well, as the light cannot fall upon ſtatues to ſuch advantage in any direction, as when it comes from above, in ſuch a regular, proportioned, and uninterrupted manner.

13 Ancient architecture ſuperior in grandeur to the modern.

We have already taken notice, that among the ancient Egyptians, Perſians, and Babylonians, the vaſt ſtrength and extent of their buildings ſeems to have been what they chiefly valued; and in this they certainly as much excelled the Greeks and modern nations, as the latter excel them in the beautiful proportion and elegance of their ſtructures. There are not wanting, however, ſome modern authors, who endeavour to deprive the ancients of what is juſtly their due, and will have every thing to be exaggerated which ſeems beyond the power of modern princes to accompliſh. In this way M. Goguet remarkably diſtinguiſhes himſelf; and that without giving any reaſon at all, but merely that he takes it into his head. Speaking of the wonders of ancient Babylon, "All theſe works (ſays he), ſo marvellous in the judgment of antiquity, appear to me to have been extremely exaggerated by the authors who have ſpoken of them. How can we conceive, in effect, that the walls of Babylon could have been 318 feet high and 81 in thickneſs, in a compaſs of near ten leagues?" To this we may eaſily reply, that the pyramids of Egypt, and the immenſe wall which divides China from Tartary, ſhow us, that even ſuch a work as the wall of ancient Babylon is ſaid to have been is not altogether incredible. The loweſt computation of the dimenſion of the Chineſe wall is, that it extends in length 1200 miles, is eighteen feet high at a medium, and as many thick; according to which computation, it muſt contain 9,504,000 ſolid fathoms; and yet, if we may credit the Chineſe hiſtorians, this immenſe maſs of building was finiſhed in five years. If therefore we can ſuppoſe Nebuchadnezzar, or whoever fortified the city of Babylon, to have been capable of employing as many men for 10 years as were employed in raiſing the Chineſe wall, we may ſuppoſe him able to have fortified the city of Babylon as ſtrongly as it is ſaid to have been; for the maſs of building is not quite double that of the Chineſe wall, though nearly ſo, amounting to 18,189,600 ſolid fathoms. When our author afterwards gaſconades about the works of the French king, it is difficult to avoid laughter at hearing him declare, that "infinitely more money has been expended, and much more genius required, as well as more power, taſte, and time, to finiſh Verſailles, with all its defects, than to conſtruct a pyramid, or erect an obeliſk." The genius, taſte, and time, we ſhall not diſpute; but as the ſame author confeſſes that 100,000 men were employed for 30 years together in the conſtruction of the largeſt pyramid, we think the power may juſtly be doubted. This doubt will appear ſtill the more reaſonable, when we conſider what time the abovementioned number of men would have taken to accompliſh ſome of the works of which M. Goguet boaſts ſo much. The canal of Languedoc, he tells us, extends in length upwards of 70 leagues, and required the removal of two millions of cubic fathoms of earth. This was no doubt a great work; but had 100,000 men been employed upon it at once, they muſt have removed this quantity of earth in three weeks, ſuppoſing each to have removed only a ſingle fathom a day. Nor can we imagine, that any modern work will at all ſtand in competition with the works of the ancients as to greatneſs, whatever they may do in other reſpects.

14 Architecture improved by the Greeks.

As to the improvements in architecture, the Greeks were undoubtedly the firſt European nation who began to diſtinguiſh themſelves in this way. Whence they took the firſt hint of improvement, we have no means of knowing: though, as we have already hinted, it is ſcarce credible but that Solomon's temple muſt have ſomewhat contributed thereto; eſpecially as we learn from Scripture, that the capitals of the columns there were ornamented in the richeſt manner. The origin of the Doric and Ionic orders we have already given an account of from Vitruvius; to which we may add, that the volutes, which are the peculiar ornament of the Ionic capital, are by ſome ſaid to repreſent the natural curling down of a piece of bark from the top of a beam, which is ſuppoſed to have been the firſt kind of column.—

15 Origin of the Corinthian order.

The Corinthian order was not invented till long after the others, and is ſaid to have taken its riſe from the following accident: A baſket had been ſet upon the ground, and covered with a ſquare tile; there grew near it a plant of acanthus or bears-breech; the leaves ſhot up and covered the outer ſurface of the baſket; and as the ſtalks roſe up among them, they ſoon reached the tile which overhung the edges of the baſket at the top; this ſtopping their courſe upwards, they curled and twiſted themſelves into a kind of volutes. In this ſituation a ſculptor, Callimachus, ſaw it; the twiſted part of the ſtalk repreſented to him the volutes of the Ionic capital, which, as they were here ſmaller, and more numerous, appeared in a new form: he ſaw the beauty of raiſing them among leaves, and was ſtruck with the repreſentation of a noble and lofty capital; which being afterwards put into execution, has been univerſally admired.

16 Private houſes of the Greeks.

In their private houſes the Greeks had greater convenience, but much leſs magnificence, than the Romans, as the former reſerved the uſe of their grandeſt architecture for their temples and public buildings. The entrance to their private houſes, however large they were, was always ſmall, narrow, and plain. The whole edifice uſually conſiſted of two courts, and ſeveral ranges of building. The porter's lodge, if ſuch a phraſe may be allowed, was uſually on the right hand of this narrow entrance, and oppoſite to this were the ſtables. From this entrance one came into the firſt or ſmaller court. This had piazzas on three ſides; and on the fourth, which was uſually the ſouth ſide, there were butments of pilaſters, which ſupported the more inward parts of the ceiling.—A ſpace being thus left between the one and the other, they had places for the lodgings of men and maid ſervants, and ſuch as had the principal care of the houſe. Upon the ſame floor with theſe butments they had ſeveral regular apartments, conſiſting of an antichamber, a chamber, and cloſets; and about the piazzas, rooms for eating, and other common purpoſes.—Oppoſite to the entrance was a lobby or veſtibule, through which lay the paſſage into the ſeveral rooms; and through this, in front, one entered a large paſſage, which led into the larger or principal ſquare. Round this they had four piazzas, which, in the common way of building, were all of one height; but, in more magnificent houſes, they made that which faced

faced the great entrance loftier, and every way nobler, than the other three. A nobleman of Rhodes added this to the common method of building; and it was thence called the *Rhodian* manner. In this more noble part of the building were the apartments of the family. Theſe were adorned with lofty galleries, and here were the beſt rooms: they were called the *mens apartments;* for, in rude times, the Greeks lodged their wives and female relations in the beſt rooms of the firſt court, where they had alſo their ſeparate and detached place. The two ſides of this larger court were kept for the reception of viſitors; and ſervants were appointed to wait upon them. The maſter of the houſe entertained his gueſts the firſt day in his own apartments; but after this, how long ſoever they ſtaid, they lived without reſtraint in one of thoſe ſeparate piazzas, and joined the family only when they choſe it. Thus was the upper end and two ſides of the great court diſpoſed of; and its lower end, being the ſame range of building that was the upper end of the firſt court, held the lady of the houſe and her female friends.

17 Of the Romans.

The Romans borrowed their architecture from the Greeks, but did not imitate them in the modeſty of their private dwellings. They placed the principal front of their houſe towards the ſouth, and on this they beſtowed all the decoration of expenſive ornament. They had here lofty galleries and ſpacious rooms, and every thing carried an air of greatneſs and ſhow. In their country houſes they preſerved the ſame ſituation and the ſame front, but the inner diſtribution was different. At the entrance they placed the meaner and more offenſive offices, after the manner of the Greeks. The firſt gallery, which received the ſtranger at his entrance, had on one ſide a paſſage to the kitchen, and on the other to the ſtalls where they kept cattle, that their noiſe or ſmell might not be offenſive within, while yet they were in readineſs for all ſervices. Theſe ſtalls were placed to the left, as in the Greek houſes; on the right was the kitchen, which had its light from above, and its chimney in the middle. Farther within the building were placed on one ſide bathing-rooms, and on the other family-conveniences, in the manner of our butteries and ſtore-rooms: the bathing-rooms were on the left, and the others on the right. Backwards, and full to the north, they placed their cellars, for fear of the ſun, and over theſe were other ſtore-rooms. From this part of the ſtructure one came into the court; for in theſe there generally was only one court: this was taken up by ſervants, and thoſe who had the care of the cattle; and on each ſide there were ſtalls for the cattle. In front from the entrance, but very far from all theſe annoyances, ſtood the nobler apartments for the maſter of the family.

18 Decline of the art among the Romans.

How magnificent the Romans were in their temples and public buildings, is yet to be ſeen in what remains of them, and which are not only models for all modern architects, but have never been ſurpaſſed or even equalled to this day. But though the art of architecture continued almoſt at its higheſt pitch among the Romans for two centuries, it declined exceedingly as the empire began to fail. Tacitus relates, that after the battle of Actium no men of genius appeared; and after the reign of Alexander Severus, a manner of building altogether confuſed and irregular was introduced, wherein nothing of the true graces and majeſty of the former was preſerved.

19 Gothic manner of building.

When the empire was entirely over-run by the Goths, the conquerors naturally introduced their own method of building. Like the ancient Egyptians, the Goths ſeem to have been more ſtudious to amaze people with the greatneſs of their buildings than to pleaſe the eye with the regularity of their ſtructure, or the propriety of their ornaments. They corrected themſelves, however, a little by the models of the Roman edifices which they ſaw before them: but theſe models themſelves were faulty; and the Goths being totally deſtitute of genius, neither architecture nor any other art could be improved by them.

Moſt writers who mention the ancient buildings in Britain, particularly the religious ones, notwithſtanding the ſtriking difference in the ſtyles of their conſtruction, claſs them all under the common denomination of *Gothic;* a general appellation by them applied to buildings not exactly conformable to ſome one of the five orders of architecture. Our modern antiquaries, more accurately, divide them into Saxon,—Norman,—and Saracenic, or that ſpecies vulgarly tho' improperly called *modern Gothic.*

20 Of the Saxon and Norman ſtyles.

It has been maintained by ſome, that the Saxon churches, after they began to be built with ſtone, conſiſted only of upright walls, without pillars or arches, the conſtruction of which it is alleged they were entirely ignorant of. But this opinion is not only contradicted by the teſtimony of ſeveral contemporary or very ancient writers, who expreſsly mention them both, but alſo by the remains of ſome edifices univerſally allowed to be of Saxon workmanſhip, one of them the ancient conventual church at Ely. Indeed, it is highly improbable that the Saxons could be ignorant of ſo uſeful a contrivance as the arch. Many of them, built by the Romans, they muſt have had before their eyes; ſome of which have reached our days: two particularly are now remaining in Canterbury only; one in the caſtle-yard, the other at Riding-gate. And it is not to be believed, that once knowing them and their convenience, they would neglect to make uſe of them; or having uſed, would relinquiſh them. Beſides, as it appears from undoubted authorities they procured workmen from the Continent to conſtruct their capital buildings, "according to the Roman manner," this alone would be ſufficient to confute that ill-grounded opinion; and at the ſame time proves, that what we commonly call *Saxon,* is in reality Roman architecture.

This was the ſtyle of building practiſed all over Europe; and it continued to be uſed by the Normans, after their arrival here, till the introduction of what is called the *modern Gothic,* which was not till about the end of the reign of Henry II. ſo that there ſeems to be little or no grounds for a diſtinction between the Saxon and Norman architecture. Indeed it is ſaid, the buildings of the latter were of larger dimenſions both in height and area; and they were conſtructed with a ſtone brought from Caen in Normandy, of which their workmen were peculiarly fond: but this was ſimply an alteration in the ſcale and materials, and not in the manner of the building. The ancient parts of moſt of our cathedrals are of this early Norman work.—The characteriſtic marks of this ſtyle are theſe: The walls are very thick, generally without buttreſſes; the arches, both within and without, as well as thoſe over the doors and windows, ſemicircular, and ſupported by very

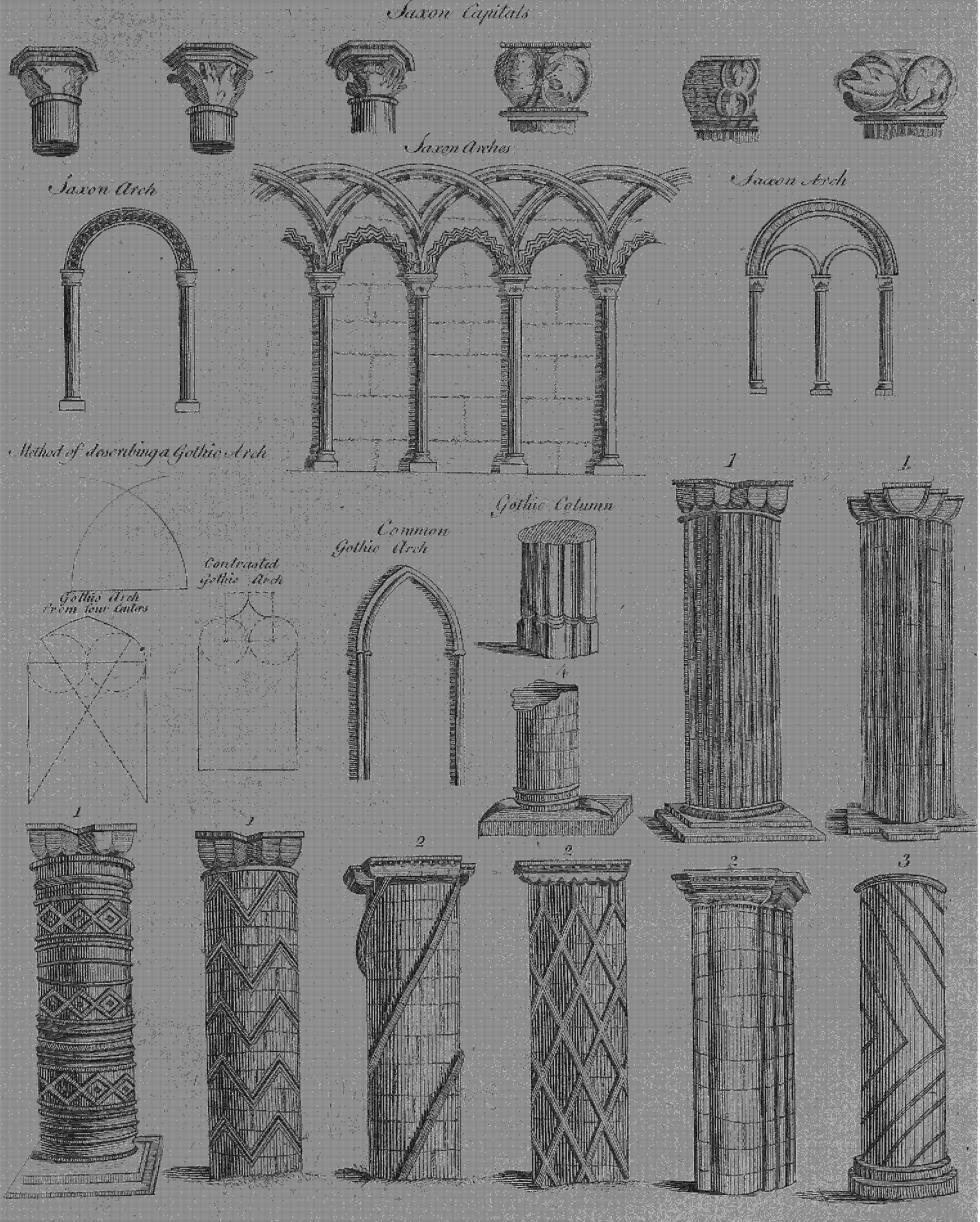
very solid, or rather clumsy, columns, with a kind of regular base and capital: in short, plainness and solidity constitute the striking features of this method of building. Nevertheless, the architects of those days sometimes deviated from this rule: their capitals were adorned with carvings of foliage, and even animals; and their massive columns decorated with small half columns united to them, and their surfaces ornamented with spirals, squares, lozenge net-work, and other figures, either engraved or in relievo. Various instances of these may be seen in the cathedral of Canterbury, particularly the under-croft, the monastery at Lindisfarn or Holy island, the cathedral at Durham, and the ruined Choir at Orford in Suffolk. The columns 1, 1, 1, 1, (Plate XXXV.), are at the monastery of Lindisfarn or Holy island. Those 2, 2, 2, belong to the ruined chancel at Orford in Suffolk. N° 3 is at Christ-church, Canterbury. N° 4, a column with two remarkable projections like claws, in the south aisle of Romsey-church, Hampshire.

21
Of the modern Gothic or Saracenic style.

To what country or people the *modern Gothic*, or the style of building with pointed arches so called, owes its origin, seems by no means satisfactorily determined. Some have imagined it may possibly have taken its rise from those arcades we see in the early Norman or Saxon buildings or walls, where the wide semicircular arches cross and intersect each other, and form at their intersection a narrow and sharp-pointed arch: But it is more generally conjectured to be of Arabian extraction, and to have been introduced into Europe by some persons returning from the Crusades in the Holy Land. Sir Christopher Wren was of that opinion, and it has been subscribed to by most writers who have treated on this subject.

"Modern Gothic, as it is called (Says Rious), is distinguished by the lightness of its work, by the excessive boldness of its elevations and of its sections; by the delicacy, profusion, and extravagant fancy of its ornaments. The pillars of this kind are as slender as those of the ancient Gothic are massive; such productions, so airy, cannot admit the heavy Goths for their author. How can be attributed to them a style of architecture, which was only introduced in the tenth century of our æra, several years after the destruction of all those kingdoms, which the Goths had raised upon the ruins of the Roman empire, and at a time when the very name of Goth was entirely forgotten? From all the marks of the new architecture, it can only be attributed to the Moors; or, what is the same thing, to the Arabians or Saracens, who have expressed, in their architecture, the same taste as in their poetry; both the one and the other falsely delicate, crowded with superfluous ornaments, and often very unnatural: the imagination is highly worked up in both; but it is an extravagant imagination; and this has rendered the edifices of the Arabians (we may include the other orientals) as extraordinary as their thoughts. If any one doubts of this assertion, let us appeal to any one who has seen the mosques and palaces of Fez, or some of the cathedrals in Spain built by the Moors: one model of this sort is the church at Burgos; and even in Britain there are not wanting several examples of the same; such buildings have been vulgarly called modern Gothic, but their true appellation is Arabic, Saracenic, or Moresque.—This manner was introduced into Europe through Spain. Learning flourished among the Arabians all the time that their dominion was in full power; they studied philosophy, mathematics, physic, and poetry. The love of learning was at once excited; in all places that were not at too great a distance from Spain, these authors were read; and such of the Greek authors as they had translated into Arabic, were from thence turned into Latin. The physic and philosophy of the Arabians spread themselves in Europe, and with these their architecture: many churches were built after the Saracenic mode; and others with a mixture of heavy and light proportions, the alteration that the difference of the climate might require, was little, if at all considered. In most southern parts of Europe, and in Africa, the windows (before the use of glass), made with narrow apertures, and placed very high in the walls of the building, occasioned a shade and darkness within side, and were all contrived to guard against the fierce rays of the sun; yet were ill suited to latitudes, where that glorious luminary sheds its feebler influences, and is rarely seen but through a watery cloud."

Mr Grose, however, thinks the above opinion is not sufficiently favoured by the observations of several learned travellers who have accurately surveyed the ancient mode of building in those parts of the world. Thus Cornelius le Brun, an indefatigable and inquisitive traveller, has published many views of eastern buildings, particularly about the Holy Land: in all these, only one Gothic ruin, the church near Acre, and a few pointed arches, occur; and those built by the Christians when in possession of the country. Near Ispahan, in Persia, he gives several buildings with pointed arches: but these are bridges and caravanseras, whose age cannot be ascertained; consequently are as likely to have been built after as before the introduction of this style into Europe. At Isaphan itself, the meydoen, or grand market-place, is surrounded by divers magnificent Gothic buildings; particularly the royal mosque, and the Talael Ali-kapie, or theatre. The magnificent bridge of Alla-werdie-chan, over the river Zenderoet, 540 paces long and 17 broad, having 33 pointed arches, is also a Gothic structure; but no mention is made when or by whom these are built. The Chiaer Baeg, a royal garden, is decorated with Gothic buildings; but these were, it is said, built only in the reign of Scha Abbas, who died anno 1629. One building indeed, Mr Grose admits, seems at first as if it would corroborate this assertion, and that the time when it was erected might be in some degree fixed; it is the tomb of Abdalla, one of the apostles of Mahomet, probably him surnamed Abu Becr. "If this tomb (says he) is supposed to have been built soon after his death, estimating that even to have happened according to the common course of nature, it will place its erection about the middle of the seventh century: but this is by far too conjectural to be much depended on. It also seems as if this was not the common style of building at that time, from the temple of Mecca; where, if any credit is to be given to the print of it in Sale's Koran, the arches are semicircular. The tomb here mentioned has one evidence to prove its antiquity; that of being damaged by the injuries of time and weather. Its general appearance much resembles the east end of the chapel belonging


Saxon Capitals
Saxon Arches
Saxon Arch
Saxon Arch
Method of describing a Gothic Arch
Gothic Arch from four Centres
Contrasted Gothic Arch
Common Gothic Arch
Gothic Column
1
1
4
1
1
2
2
2
3

to Ely House, London, except that which is filled up there by the great window: in the tomb is an open pointed arch, where also the columns or pinnacles on each side are higher in proportion."

As to the supposition that this kind of architecture was brought into Spain by the Moors (who possessed themselves of a great part of that country the beginning of the eighth century, which they held till the latter end of the fifteenth), and that from thence, by way of France, it was introduced into Britain this at first seems plausible: though, accoding to Mr Grose, the only instance which seems to corroborate this hypothesis, or at least the only one proved by authentic drawings, is the mosque at Cordua in Spain; where, if we may judge from the views published by Mr Swinburn, although most of the arches are circular or horse-shoe fashion, there are some pointed arches formed by the intersection of two segments of a circle. This mosque was, as it is there said, begun by Abdoulrahman I. who laid the foundation two years before his death, and was finished by his son Hissem or Iscan about the year 800. If these arches were part of the original structure, it would be much in favour of the supposition; but as it is also said that edifice has been more than once altered and enlarged by the Mahometans, before any well-grounded conclusion can be drawn, it is necessary to ascertain the date of the present building.

There are also several pointed arches in the Moorish palace at Grenada, called the Alhambra; but as that was not built till the year 1273, long after the introduction of pointed arches into Europe, they are as likely to be borrowed by the Moors from the Christians, as by the Christians from the Moors. The greatest peculiarity in the Moorish architecture is the horse-shoe arch, which containing more than a semicircle, contracts towards its base, by which it is rendered unfit to bear any considerable weight, being solely calculated for ornament. In Romsey church, Hampshire, there are several arches somewhat of that form.

The drawings of the Moorish buildings given in *Les Delices de l'Espagne*, said to be faithful representations, there are no traces of the style called Gothic architecture: there, as well as in the Moorish castle at Gibraltar, the arches are all represented circular. Perhaps a more general knowledge of these buildings would throw some light on the subject: possibly the Moors may, like us, at different periods have used different manners of building.

The marks which constitute the character of Gothic, or Saracenical architecture, are its numerous and prominent buttresses, its lofty spires and pinnacles, its large and ramified windows, its ornamental niches or canopies, its sculptured saints, the delicate lace-work of its fretted roofs, and the profusion of ornaments lavished indiscriminately over the whole building: but its peculiar distinguishing characteristics are, the small clustered pillars and pointed arches formed by the segments of two intersecting circles; which arches, though last brought into use, are evidently of more simple and obvious construction that the semicircular ones; two flat stones, with their tops inclined to each other, and touching, form its rudiments; a number of boughs stuck into the ground opposite each other, and tied together at the top, in order to form a bower, exactly describe it: whereas a semicircular arch appears the result of deeper contrivance, as consisting of more parts; and it seems less probable chance, from whence all these inventions were first derived, should throw several wedge-like stones between two set perpendicular, so as exactly to fit and fill up the interval.

Bishop Warburton, in his notes on Pope's Epistles, in the octavo edition, has the following ingenious observations on this subject:—"Our Gothic ancestors had juster and manlier notions of magnificence, on Greek and Roman ideas, than these mimics of taste, who profess to study only classic elegance; and because the thing does honour to the genius of those barbarians, I shall endeavour to explain it. All our ancient churches are called without distinction Gothic, but erroneously. They are of two sorts; the one built in the Saxon times, the other in the Norman. Several cathedral and collegiate churches of the first sort are yet remaining, either in whole or in part; of which this was the original: When the Saxon kings became Christians, their piety (which was the piety of the times) consisted chiefly in building churches at home, and performing pilgrimages abroad, especially to the Holy Land; and these spiritual exercises assisted and supported one another; for the most venerable as well as most elegant models of religious edifices were then in Palestine. From these the Saxon builders took the whole of their ideas, as may be seen by comparing the drawings which travellers have given us of the churches yet standing in that country, with the Saxon remains of what we find at home; and particularly in that sameness of style in the latter religious edifices of the knights temporals (professedly built upon the model of the church of the Holy Sepulchre at Jerusalem), with the earlier remains of our Saxon edifices. Now the architecture of the Holy Land was Grecian, but greatly fallen from its ancient elegance. Our Saxon performance was indeed a bad copy of it, and as much inferior to the works of St Helene and Justinian, as theirs were to the Grecian models they had followed: yet still the footsteps of ancient art appeared in the circular arches, the entire columns, the division of the entablature into a sort of architrave, frize, and corniche, and a solidity equally diffused over the whole mass. This by way of distinction, I would call the Saxon architecture. But our Norman works had a very different original. When the Goths had conquered Spain, and the genial warmth of the climate and the religion of the old inhabitants had ripened their wits and inflamed their mistaken piety, both kept in exercise by the neighbourhood of the Saracens, through emulation of their service, and aversion to their superstition, they struck out a new species of architecture, unknown to Greece and Rome, upon original principles, and ideas much nobler than what had given birth even to classical magnificence. For this northern people having been accustomed, during the gloom of paganism, to worship the deity in groves (a practice common to all nations); when their new religion required covered edifices, they ingeniously projected to make them resemble groves, as nearly as the distance of architecture would permit; at once indulging their old prejudices, and providing for their present convenience, niences, by a cool receptacle in a sultry climate: and with what skill and success they executed the project by the assistance of Saracen architects, whose exotic style of building very luckily suited their purpose, appears from hence, that no attentive observer ever viewed a regular avenue of well grown trees intermixing their branches overhead, but it presently put him in mind of the long visto through the Gothic cathedral; or even entered one of the larger and more elegant edifices of this kind, but it presented to his imagination an avenue of trees; and this alone is what can be truly called the Gothic style of building. Under this idea of so extraordinary a species of architecture, all the irregular transgressions against art, all the monstrous offences against nature, disappear; every thing has its reason, every thing is in order, and an harmonious whole arises from the studious application of means proper and proportionate to the end. For could the arches be otherwise than pointed, when the workmen were to imitate that curve which branches of two opposite trees make by their insertion with one another? or could the columns be otherwise than split into distinct shafts, when they were to represent the stems of a clump of trees growing close together? On the same principles they formed the spreading ramification of the stone-work in the windows, and the stained glass in the interstices; the one to represent the branches, and the other the leaves of an opening grove, and both concurred to preserve that gloomy light which inspires religious reverence and dread. Lastly, we see the reason of their studied aversion to apparent solidity in these stupendous masses, deemed so absurd by men accustomed to the apparent as well as real strength of Grecian architecture. Had it been only a wanton exercise of the artist's skill, to show he could give real strength without the appearance of any, we might indeed admire his superior science, but we must needs condemn his ill judgment. But when one considers, that this surprising lightness was necessary to complete the execution of his idea of a sylvan place of worship, one cannot sufficiently admire the ingenuity of the contrivance. This too will account for the contrary qualities in what I call the Saxon architecture. These artists copied, as has been said, from the churches in the Holy Land, which were built on the models of the Grecian architecture, but corrupted by prevailing barbarism; and still farther depraved by a religious idea. The first places of Christian worship were sepulchres and subterraneous caverns, low and heavy from necessity. When Christianity became the religion of the state, and sumptuous temples began to be erected, they yet, in regard to the first pious ages, preserved the massive style, made still more venerable by the church of the Holy Sepulchre; where this style was, on a double account, followed and aggravated."

22
Rise and progress of architecture in Britain.

In Britain, before the Roman invasion, the natives appear to have had no better lodgings than thickets, dens, and caves. Some of these caves, which were their winter-habitations, and places of retreat in time of war, were formed and rendered secure and warm by art, like those of the ancient Germans, which are thus described by Tacitus: "They are used to dig deep caves in the ground and cover them with earth, where they lay up their provisions, and dwell in winter for the sake of warmth. Into those they retire also from their enemies, who plunder the open country, but cannot discover these subterranean recesses." Some of the subterraneous, or *earth-houses*, as they are called, are still remaining in the western isles of Scotland and in Cornwal. The summer habitations of the most ancient Britons were very slight; and, like those of the Finnians, consisted only of a few stakes driven into the ground, interwoven with wattles, and covered over with the boughs of trees.

When Julius Cæsar invaded Britain, the inhabitants of Cantium (Kent), and of some other parts in the south, had learned to build houses a little more substantial and convenient. "The country (says Cæsar) abounds in houses, which very much resemble those of Gaul." The first step towards this improvement seems to have been that of daubing the wattled walls of their houses with clay, to fill up the chinks and make them warmer. "The Germans used for this purpose a kind of pure resplendent earth of different colours, which had an appearance of painting at a distance;" but the Gauls and Britains chose rather to whitewash the clay after it was dry with chalk. Instead of the boughs of trees, they thatched these houses with straw, as a much better security against the weather. They next proceeded to form the walls of large beams of wood, instead of stakes and wattles. This seems to have been the mode of building in Britain, when it was first invaded by the Romans. "The Britons (says Diodorus Siculus, who was cotemporary with Cæsar) dwell in wretched cottages, which are constructed of wood, covered with straw." These wooden houses of the ancient Gauls and Britons were not square but circular, with high tapering roofs, at the top or centre of which was an aperture for the admission of light and emission of smoke. Those of Gaul are thus described by Strabo: "They build their houses of wood, in the form of a circle, with lofty tapering roofs." The foundations of some of the most magnificent of these circular houses were of stone, of which there are some vestiges still remaining in Anglesey and other places. It was probably in imitation of these wooden houses, that the most ancient stone edifices, of which there are still some remains in the western islands of Scotland, were built circular, and have a large aperture at the top.

When the Britons were invaded by the Romans, they had nothing among them answering to our ideas of a city or town, consisting of a great number of contiguous houses, disposed into regular streets, lanes, and courts. Their dwellings, like those of the ancient Germans, were scattered about the country, and generally situated on the brink of some rivulet for the sake of water, and on the skirt of some wood or forest for the conveniency of hunting and pasture for their cattle. As these inviting circumstances were more conspicuous in some part of the country than others, the princes and chiefs made choice of these places for their residence; and a number of their friends and followers, for various reasons, built their houses as near to them as they could with conveniency. This naturally produced an ancient British town, which is described by Cæsar and Strabo in the following manner: "From the Cassi he learnt that the town of Cassivelaun was at no great distance; a place defended by woods and marshes, in which very great numbers of men and cattle were collected. For what the Britons call a town, is is a tract of a woody country, surrounded by a mound and ditch, for the security of themselves and their cattle against the incursions of their enemies." "The forests of the Britons are their cities: for when they have inclosed a very large circuit with felled trees, they build within it houses for themselves, and hovels for their cattle. These buildings are very slight, and not designed for long duration." The palaces of the British princes were probably built of the same materials, and on the same plan, with the houses of their subjects, and differed from them only in solidity and magnitude.

Though the communication between Britain and the continent was more free and open after the first Roman invasion than it had been before, and some of the British princes and chieftans even visited Rome, then in its greatest glory; it doth not appear that the people of Britain made any considerable improvements in their manner of building for at least a hundred years after that invasion. For when the renowned Caractacus was carried prisoner to Rome, A. D. 52, and observed the beauty and magnificence of the buildings in that proud metropolis of the world, he is said to have expressed great surprise, "That the Romans, who had such magnificent palaces of their own, should envy the wretched cabbins of the Britons."

It must appear very surprising that the ancient Britons, when they were so ignorant of architecture, were capable of erecting (if indeed it was erected by them) so stupendous a fabric as that of Stonehenge on Salisbury plain: A fabric which hath been the admiration of all succeeding ages, and hath outlasted all the solid and noble structures which were erected by the Romans in that island. See the article STONEHENGE.

Of another very extraordinary species of building several remains are found in the Highlands of Scotland. They consist of ruins; the walls of which, instead of being cemented with lime or some other similar substance, or of being raised with dry stones, as was the method before cement came into use, are described as having been vitrefied, or the stones run and compacted together by the force of fire. Concerning the origin, use, &c. of these buildings, different opinions have been formed; and even the reality of them as works of contrivance has been called in question: of all which particulars the reader will find an account under the article *FORTS (Vitrefied)*.

But for whatever purposes, or by whatever means, the above and other similar structures of a peculiar nature were erected, we have sufficient evidence that the people of Britain, before they were subdued and instructed by the Romans, had but a rude knowledge of architecture, and were very meanly lodged. As soon, however, as the Romans began to form settlements and plant colonies in that island, a sudden and surprising change ensued in the state of architecture. For that wonderful people were as industrious as they were brave, and made haste to adorn every country that they conquered. The first Roman colony was planted at Camelodunum, A. D. 50; and when it was destroyed by the Britons in their great revolt under Boadicia, only eleven years after, it appears to have been a large and well built town, adorned with statutes, temples, theatres, and other public edifices.

The Romans not only built a prodigious number of solid, convenient, and magnificent structures for their own accommodation, but they exhorted, encouraged, and instructed the Britons to imitate their example. This was one of the arts which Agricola, the most excellent of the Roman governors, employed to civilize the Britons, and reconcile them to the Roman government. "The following winter (says Tacitus) was spent by Agricola in very salutary measures. That the Britons, who led a roaming and unsettled life, and were easily instigated to war, might contract a love to peace and tranquillity, by being accustomed to a more pleasant way of living, he exhorted and assisted them to build houses, temples, courts, and market-places. By praising the diligent and reproaching the indolent, he excited so great an emulation among the Britons, that after they had erected all those necessary edifices in their towns, they proceeded to build others merely for ornament and pleasure, as porticoes, galleries, baths, banqueting-houses, &c." From this time, which was A. D. 80, to the middle of the fourth century, architecture and all the arts immediately connected with it greatly flourished in that island; and the same taste for erecting solid, convenient, and beautiful buildings, which had long prevailed in Italy, was introduced into Britain. Every Roman colony and free city (of which there was a great number in that country) was a little Rome, encompassed with strong walls, adorned with temples, palaces, courts, halls, basilisks, baths, markets, aqueducts, and many other fine buildings, both for use and ornament. The country every where abounded with well-built villages, towns, forts, and stations; and the whole was defended by that high and strong wall, with its many towers and castles, which reached from the mouth of the river Tine on the east to the Solway Firth on the west. This spirit of building, which was introduced and encouraged by the Romans, so much improved the taste and increased the number of the British builders, that in the third century that island was famous for the great number and excellence of its architects and artificers. When the Emperor Constantius, father of Constantine the Great, rebuilt the city of Autun, in Gaul, A. D. 296, he was chiefly furnished with workmen from Britain, "which (says Eumenius) very much abounded with the best artificers."

Not very long after this period, architecture and all the arts connected with it began to decline very sensibly in Britain, and in all the provinces of the western empire. This was partly owing to the building of Constantinople, which drew many of the most famous architects and other artificers into the east, and partly to the irruptions and depredations of the barbarous nations.

The final departure of the Romans was followed by the almost total destruction of architecture in that island. For the unhappy and unwarlike people whom they left behind, having neither skill nor courage to defend the numerous towns, forts, and cities which they possessed, they were seized by their ferocious invaders, who first plundered and then destroyed them. By this means, the many noble structures with which Provincial Britain had been adorned by the art and industry of the Romans, were ruined or defaced in a very little time; and the unfortunate Britons were quite incapable of repairing them, or of building others in their room. That long succession of miseries in which they were involved

volved by the Scots, Picts, and Saxons, deprived them of the many useful arts which they had learned from their former masters, and lodged them once more in forests, dens, and caves, like their savage anceſtors.

The most wanton and extenſive devaſtations were thoſe committed by the Anglo-Saxons; among whom it ſeems to have been a maxim to deſtroy all the towns and caſtles which they took from their enemies, inſtead of preſerving them from their own uſe.

It cannot be ſuppoſed, that a people who wantonly demoliſhed ſo many beautiful and uſeful ſtructures had any taſte for the arts by which they had been erected. The truth is, that the Anglo-Saxons at their arrival in this iſland were almoſt totally ignorant of theſe arts; and, like all the other nations of Germany, had been accuſtomed to live in wretched hovels, built of wood or earth, and covered with ſtraw or the branches of trees: nor did they much improve in the knowledge of architecture for 200 years after their arrival. During that period, maſonry was quite unknown and unpractiſed in this iſland: and the walls even of cathedral churches were built of wood. "There was a time (ſays Venerable Bede) when there was not a ſtone church in all the land; but the cuſtom was to build them all of wood. Finan, the ſecond biſhop of Lindisfarne, or Holy iſland, built a church in that iſland, A. D. 652, for a cathedral, which yet was not of ſtone, but of wood, and covered with reeds; and ſo it continued till Eadbert, the ſucceſſor of St Cuthbert, and ſeventh biſhop of Lindisfarne, took away the reeds, and covered it all over, both roof and walls, with ſheets of lead." The firſt cathedral of York was built of the ſame materials; and a church of ſtone was eſteemed a kind of prodigy in thoſe times that merited a place in hiſtory. "Paulinus, the firſt biſhop of York, built a church of ſtone in the city of Lincoln, whoſe walls (ſays Bede) are ſtill ſtanding, though the roof is fallen down; and ſome healing miracles are wrought in it every year, for the benefit of thoſe who have the faith to ſeek them."

There does not ſeem to have been ſo much as one church of ſtone, nor any artiſts who could build one, in all Scotland, at the beginning of the eighth century. For Naitan king of the Picts, in his famous letter to Ceolfred abbot of Weremouth, A. D. 710, earneſtly intreats him to ſend him ſome maſons to build a church of ſtone in his kingdom, in imitation of the Romans; which he promiſes to dedicate to the honour of the apoſtle Peter, to whom the abbey of Weremouth was dedicated: and we are told by Bede, who was then living in that abbey, that the reverend abbot Ceolfred granted this pious requeſt, and ſent maſons according to his deſire.

Maſonry was reſtored, and ſome other arts connected with it introduced into England, towards the end of the ſeventh century, by two clergymen, who were great travellers, and had often viſited Rome, where they had acquired ſome taſte for theſe arts. Theſe were, the famous Wilfrid biſhop of York, and afterwards of Hexham, and Benedict Biſcop, founder of the Abbey of Weremouth. Wilfrid, who was one of the moſt ingenious, active, and magnificent prelates of the ſeventh century, was a great builder, and erected ſeveral ſtructures at York, Rippon, and Hexham, which were the admiration of the age in which he flouriſhed. The cathedral of Hexham, which was one of theſe ſtructures, is thus deſcribed by his biographer: "Having obtained a piece of ground at Hexham from Qeen Etheldreda, he there founded a moſt magnificent church, which he dedicated to the bleſſed apoſtle St Andrew. As the plan of this ſacred ſtructure ſeems to have been inſpired by the Spirit of God, it would require a genius much ſuperior to mine to deſcribe it properly. How large and ſtrong were the ſubterraneous buildings conſtructed of the fineſt poliſhed ſtones! How magnificent the ſuperſtructure, with its lofty roof, ſupported by many pillars, its long and high walls, its ſublime towers, and winding ſtairs! In one word, there is no church on this ſide of the Alps ſo great and beautiful." This admired edifice, of which ſome veſtiges are ſtill remaining, was built by maſons and other artificers brought from Rome by the munificence of its generous founder. Benedict Biſcop was the cotemporary and companion of Wilfrid in ſome of his journeys, and had the ſame taſte for the arts. He made no fewer than ſix journeys to Rome, chiefly with a view of collecting books, pictures, ſtatues, and other curioſities, and of perſuading artificers of various kinds to come from Italy and France and ſettle in England. Having obtained a grant of a conſiderable eſtate from Egfrid king of Northumberland, near the mouth of the river Were, he there founded a monaſtery, A. D. 647. "About a year after the foundations of this monaſtery were laid, Benedict croſſed the ſea into France, where he collected a number of maſons, and brought them over with him, in order to build the church of his monaſtery of ſtone after the Roman manner, of which he was a great admirer. His love to the apoſtle Peter, to whom he deſigned to dedicate his church, made him urge theſe workmen to labour ſo hard, that maſs was celebrated in it about a year after it was founded. When the work was far advanced, he ſent agents into France to procure if poſſible ſome glaſs-makers, a kind of artificers quite unknown in England, and to bring them over to glaze the windows of his church and monaſtery. Theſe agents were ſucceſsful, and brought ſeveral glaſs-makers with them; who not only performed the work required by Benedict, but inſtructed the Engliſh in the art of making glaſs for windows, lamps, drinking-veſſels, and other uſes."

Eddii Vita Wilfridi, c. 22.

Bedæ Hiſt. Abbat.

But though theſe arts of building edifices of ſtone, with windows of glaſs and other ornaments, were thus introduced by theſe two prelates in the latter part of the ſeventh century, they do not ſeem to have flouriſhed much for ſeveral centuries. It appears from many incidental hints in our ancient hiſtorians, that ſtone-buildings were ſtill very rare in the eighth and ninth ages; and that when any ſuch buildings were erected, they were the objects of much admiration. When Alfred the Great, towards the end of the ninth century, formed the deſign of rebuilding his ruined cities, churches, and monaſteries, and of adorning his dominions with more magnificent ſtructures, he was obliged to bring many of his artificers from foreign countries. "Of theſe (as we are told by his friend and companion Aſſerius) he had an almoſt innumerable multitude, collected from different nations; many of them the moſt excellent in their ſeveral arts."

In the other parts of the iſland architecture was, as might

might naturally be imagined, in a still less flourishing state. It appears indeed to have been almost entirely lost among the posterity of the ancient Britons after they retired to the mountains of Wales. The chief palace of the kings of Wales, where the nobility and wise men assembled for making laws, was called the *white palace*, because the walls of it were woven with white wands which had the bark peeled off. By the laws of Wales, whoever burnt or destroyed the king's hall or palace was obliged to pay one pound and eighty pence, besides one hundred and twenty pence for each of the adjacent buildings, which were eight in number; viz. the dormitory, the kitchen, the chapel, the granary, the bake-house, the store-house, the stable, and the dog-house. From hence it appears, that a royal residence in Wales, with all its offices, when these laws were made, was valued at five pounds and eighty pence of the money of that age, equal in quantity of silver to sixteen pounds Sterling, and in efficacy to one hundred and sixty. This is certainly a sufficient proof of the meanness of those buildings which were only of wood. Even the castles in Wales, in this period, that were built for the security of the country, appear to have been constructed of the same materials; for the laws required the king's vassals to come to the building of these castles with no other tools but an axe.

The arts of building do not seem to have been much better understood by the Scots and Picts than by the ancient Britons in the former part of this period. When Finan, the second bishop of Lindisfarne, built a church of wood in that island, A. D. 652, he is said to have done it *more Scotorum*, after the manner of his countrymen the Scots; and it hath been already observed, that Naitan king of the Picts was obliged to bring masons from Northumberland when he resolved to build a church of stone in his dominions, A. D. 710. After this last period, it is probable that the Picts, and perhaps the Scots, began to learn and practise the art of masonry; because there are still some stone buildings of a very singular construction, and great antiquity, to be seen in Scotland. These buildings are all circular; though of two kinds so different from each other, that they seem to be the works of different ages and of different nations. The largest of these structures are in a very extraordinary taste of architecture; and are thus described by a modern antiquary, who viewed them with no little attention: "Having arrived at the barrack of Glenelg, I was conducted to the remains of those stupendous fabrics, seated about two miles from thence, in a valley called *Glenbeg*, in which four of them anciently stood. Two of these are now almost quite demolished, the third is half fallen down, the fourth is almost entire. The first I met with lies towards the north side of the valley, and is called *Castle Chalamine*, or *Malcom's Castle*. It stands upon a considerable eminence, and affords us a fine prospect of the island of Sky, and a good part of the sea-coast. The foundation of this only appears; as also of that other, on the east end of the valley, called *Castle Chonnel*. About a quarter of a mile further, upon the bank of a rivulet which passes through the middle of the glen, stands the third fabric, called *Castle Tellve*. I found it composed of stones without cement; not laid in regular courses, after the manner of elegant buildings, but rudely and without order. Those toward the base were pretty large, but ascending higher they were thin and flat, some of them scarce exceeding the thickness of an ordinary brick. I was surprised to find no windows on the outside, nor any manner of entrance into the fabric, except a hole towards the west, at the base, so very low and narrow, that I was forced to creep in upon hands and knees, and found that it carried me down four or five steps below the surface of the ground. When I was got within, I was environed betwixt two walls, having a cavity or void space which led me round the whole building. Opposite to the little entry on the outside was a pretty large door in the second or inner wall, which let me into the area or inner court. When I was there, I perceived that one half of the building was fallen down, and thereby had the opportunity of seeing a complete section thereof. The two walls join together at the top, round about, and have formed a large void space or area in the middle. But to give a more complete idea of these buildings, I shall describe the fourth, called *Castle Troddan*, which is by far the most entire of any in that country, and from whence I had a very clear notion how these fabrics were originally contrived. On the outside were no windows, nor were the materials of this castle any wise different from those of the other already described, only the entry on the outside was somewhat larger; but this might be occasioned by the falling of the stones from above. The area of this makes a complete circle; and there are four doors in the inner wall, which face the four cardinal points of the compass. These doors are each eight feet and a half high, and five feet wide, and lead from the area into the cavity between the two walls, which runs round the whole building. The perpendicular height of this fabric is exactly 33 feet; the thickness of both walls, including the cavity between, no more than 12 feet; and the cavity itself is hardly wide enough for two men to walk abreast: the external circumference is 178 feet. The whole height of the fabric is divided into four parts or stories, separated from each other by thin floorings of flat stones, which knit the two walls together, and run quite round the building; and there have been winding stairs of the same flat stones ascending betwixt wall and wall up to the top. The undermost partition is somewhat below the surface of the ground, and is the widest; the others grow narrower by degrees till the wall closes at the top. Over each door are nine square windows, in a direct line above each other, for the admission of light; and between every row of windows are three others in the uppermost story, rising above a cornice which projects out from the inner wall and runs round the fabric." From this description of these singular edifices, it plainly appears, that they were designed both for lodging and defence; and considering the state of the times in which they were built, they were certainly very well contrived for answering both these purposes.

Gordon's Itinerarium Septentrionale, p. 166.

The stone edifices of the other kind which were probably erected in this period, and of which some few are still to be seen in Scotland, are not so large as the former, but more artificial. They are slender, lofty, circular towers, of cut stone, laid in regular rows, between 40 and 50 feet in external circumference, and from 70 to 100 feet high, with one door some feet from the ground. They are exactly similar to the round

round tower of Ardmore, and several others in Ireland; and therefore were probably built about the same time, which was in the tenth century, and for the same purposes; which are believed by some to have been for the confinement of penitents while they were performing penance. On this account these towers are always found in the neighbourhood of churches both in Scotland and Ireland; and are said to have been used in this manner: "The penitents were placed in the uppermost story of the tower (which commonly consisted of five or six stories); where having made probation, or done penance, such a limited time, according to the heinousness of their crimes, they then were permitted to descend to the next floor, and so on by degrees, until they came to the door, which always faced the entrance of the church, where they stood to receive absolution from the clergy, and the blessings of the people." A tedious process, to which few penitents in the present age would willingly submit. Other writers are of opinion, that the design of these circular towers (of which one is still remaining at Abernethy, and another at Brechin) was to be places from whence the people were called to public worship by the sound of a horn or trumpet, before the introduction of bells.

Archæologia vol. i. p. 307.

This art received very great improvements in the 12th century; which indeed may be called *the age of architecture*; when the rage for building was more violent in England than at any other time. The great and general improvements that were made in the fabrics of houses and churches in the first years of this century, are thus described by a cotemporary writer. "The new cathedrals and innumerable churches that were built in all parts, together with the many magnificent cloisters and monasteries, and other apartments of monks, that were then erected, afford a sufficient proof of the great felicity of England in the reign of Henry I. The religious of every order, enjoying peace and prosperity, displayed the most astonishing ardour in every thing that might increase the splendor of divine worship. The fervent zeal of the faithful prompted them to pull down houses and churches every where, and rebuild them in a better manner. By this means the ancient edifices that had been raised in the days of Edgar, Edward, and other Christian kings, were demolished, and others of greater magnitude and magnificence, and of more elegant workmanship, were erected in their room, to the glory of God."

Oraeric. Vital. Hist. Eccles. p. 788.

As the prodigious power of religious zeal, whatever turn it happens to take, when it is thoroughly heated, is well known, it may not be improper to give one example of the arts employed by the clergy and monks of this period, to inflame the pious ardour of the kings, nobles, and people, for building and adorning churches. When Joffred Abbot of Croyland resolved to rebuild the church of his monastery in a most magnificent manner, A. D. 1106, he obtained from the Archbishops of Canterbury and York, a bull dispensing with the third part of all penances for sin to those who contributed any thing towards the building of that church. This bull was directed not only to the king and people of England, but to the kings of France and Scotland, and to all other kings, earls, barons, archbishops, bishops, abbots, priors, rectors, presbyters, and clerks, and to all true believers in Christ, rich and poor, in all Christian kingdoms. To make the best use of this bull, he sent two of his most eloquent monks to proclaim it over all France and Flanders, two other monks into Scotland, two into Denmark and Norway, two into Wales, Cornwall, and Ireland, and others into different parts of England. "By this means (says the historian) the wonderful benefits granted to all the contributors to the building of this church were published to the very ends of the earth; and great heaps of treasure and masses of yellow metal flowed in from all countries upon the venerable Abbot Joffred, and encouraged him to lay the foundations of his church." Having spent about four years in collecting mountains of different kinds of marble from quarries both at home and abroad, together with great quantities of lime, iron, brass, and other materials for building, he fixed a day for the great ceremony of laying the foundation, which he contrived to make a very effectual mean of raising the superstructure: For on the long-expected day, the feast of the Holy Virgins Felicitas and Perpetua, an immense multitude of earls, barons, and knights, with their ladies and families, of abbots, priors, monks, nuns, clerks, and persons of all ranks, arrived at Croyland, to assist at this ceremony. The pious Abbot Joffred began by saying certain prayers, and shedding a flood of tears on the foundation. Then each of the earls, barons, knights, with their ladies, sons, and daughters, the abbots, clerks, and others, laid a stone, and upon it deposited a sum of money, a grant of lands, tithes, or patronages, or a promise of stone, lime, wood, labour, or carriages for building the church. After this the abbot entertained the whole company, amounting to 5000 persons, at dinner. To this entertainment they were all intitled; for the money, and grants of different kinds, which they had deposited on the foundation-stones, were alone sufficient to have raised a very noble fabric. By such arts as these the clergy inspired kings, nobles, and people of all ranks, with so ardent a spirit for these pious works, that in the course of this period almost all the sacred edifices in England were rebuilt, and many hundreds of new ones raised from the foundation. Nor was this spirit confined to England, but prevailed as much in Scotland in proportion to its extent and riches. King David I. alone, besides several cathedrals and other churches, built no fewer than thirteen abbeys and priories, some of which were very magnificent structures.

The sacred architecture of the Anglo-Normans in the beginning of this period did not differ much in its style and manner from that of the Anglo-Saxons; their churches being in general plain, low, strong, and dark; the arches both of the doors and windows semicircular, with few or no ornaments. By degrees, through much practice, our architects, who were all monks or clergymen, improved in their taste and skill, and ventured to form plans of more noble, light, and elevated structures, with a great variety of ornaments; which led to that bold magnificent style of building, commonly, though perhaps not very properly, called *the later Gothic*. It is not improbable that our monkish architects were assisted in attaining this style of building by models from foreign countries, or by instructions from such of their own number as had visited Italy, France, Spain, or the East. But the origin

of

of this style of architecture has been already considered, and the characters by which it is distinguished from the ancient Gothic have also been described: (See n° 21. *supra*.) Its first appearance in England was towards the latter end of the reign of King Henry II. But it was not at once thoroughly adopted; some short solid columns and semicircular arches being retained and mixed with the pointed ones; as for example, in the west end of the Old Temple Church; and at York, where under the choir there remains much of the ancient work, the arches of which are but just pointed and rise on short round pillars. In the reign of Henry III. however, this manner of building seems to have gained a complete footing; the circular giving place to the pointed arch, and the massive column yielding to the slender pillar. Indeed, like all novelties, when once admitted, the rage of fashion made it become so prevalent, that many of the ancient and solid buildings, erected in former ages, were taken down in order to be re-edified in the new taste, or had additions patched to them, of this mode of architecture. The present cathedral church of Salisbury was begun early in this reign, and finished in the year 1258. It is entirely in the Saracenic style; and, according to Sir Christopher Wren, may be justly accounted one of the best paterns of architecture of the age in which it was built. Its excellency is undoubtedly in a great measure owing to its being constructed on one plan; whence arises that symmetry and agreement of parts, not to be met with in many of our other cathedral churches; which have mostly been built at different times, and in a variety of styles. From this time till the reign of Henry VIII. the fashionable pillars in churches were of Purbic marble, very slender and round, encompassed with marble shafts a little detached, having each a capital adorned with foliage, which joining, formed one elegant capital for the whole pillar. The windows were long and narrow, with pointed arches and painted glass, which was introduced about that time, or at least became more common. In this century also they began to delight in lofty steeples, with spires and pinnacles. In the fourteenth century, the pillars consisted of an assemblage of shafts not detached, but united, forming one solid and elegant column; the windows, especially those in the east and west ends, were greatly enlarged, divided into several lights by stone mullions running into ramifications above, and forming numerous compartments in various fanciful shapes. Those windows, filled with stained glass of the most lively colours, representing kings, saints, and martyrs, and their histories, made a most solemn and glorious appearance. There were several other variations, especially in the taste of the carvings and other ornaments, which are too minute for general history.

As to the state of civil architecture during the same period: The houses of the common people in the country, and of the lower burgesses in towns and cities, were very little improved in their structure, that most numerous and useful order of men being much depressed in the times we are now delineating. Even in the capital city of London, all the houses of mechanics and common burgesses were built of wood, and covered with straw or reeds, towards the end of the twelfth century. But the palaces, or rather castles, of the Anglo-Norman kings, barons, and prelates, were very different from the residences of persones of the same rank in the Anglo-Saxon times. For this we have the testimony of a person of undoubted credit, who was well acquainted with them both. "The Anglo-Saxon nobles (says William of Malmsbury) squandered away their ample revenues in low and mean houses; but the French and Norman barons are very different from them, living at less expence, but in great and magnificent palaces." The truth is, that the rage of building fortified castles, was no less violent among the Norman princes, prelates, and barons, than that of building churches. To this they were prompted, not only by the custom of their native country, but also by their dangerous situation in that island. Surrounded by multitudes, whom they had depressed and plundered, and by whom they were abhorred, they could not think themselves safe without the protection of deep ditches and strong walls. The conqueror himself was sensible, that the want of fortified places in England had greatly facilitated his conquest, and might facilitate his expulsion; and therefore he made all possible haste to remedy this defect, by building very magnificent and strong castles in all the towns within the royal demesnes. "William (says Matthew Paris) excelled all his predecessors in building castles, and greatly harassed his subjects and vassals with these works." All his earls, barons, and even prelates, imitated his example; and it was the first care of every one who received the grant of an estate from the crown, to build a castle upon it for his defence and residence. The disputes about the succession in the following reigns, kept up this spirit for building great and strong castles. William Rufus was still a greater builder than his father. "This William (says Henry Knyghton) was much addicted to building royal castles and palaces, as the castles of Dover, Windsor, Norwich, Exeter, the palace of Westminster, and many others, testify; nor was there any king of England before him that erected so many and such noble edifices." Henry I. was also a great builder both of castles and monasteries. But this rage for building never prevailed so much in any period of the English history as in the turbulent reign of king Stephen, from A. D. 1135 to A. D. 1154. "In this reign (as we are told by the author of the Saxon Chronicle) every one who was able built a castle; so that the poor people were worn out with the toil of these buildings, and the whole kingdom was covered with castles." This last expression will hardly appear too strong, when we are informed, that besides all the castles before that time in England, no fewer than 1115 were raised from the foundation in the short space of 19 years. See the article CASTLE.

The castles, monasteries, and greater churches of this period, were generally covered with lead, the windows glazed; and when the walls were not of Ashler, they were neatly plastered, and whitewashed on both sides. The doors, floors, and roof, were commonly made of oak planks and beams, exactly smoothed and jointed, and frequently carved. It is hardly necessary to observe, that the building one of these great and magnificent castles, monasteries, or churches, of which there were many in England, must have been a work of prodigious expence and labour; and that the architects and artificers, by whom that work was planned and executed, must have attained considerable dexterity

dexterity in their respective arts. Several of these architects have obtained a place in history, and are highly celebrated for their superior skill. William of Sens, architect to Archbishop Lanfranc in building his cathedral, is said, by Gervase of Canterbury, to have been a most exquisite artist both in stone and wood. He made not only a model of the whole cathedral, but of every particular piece of sculpture and carving, for the direction of the workmen; and invented many curious machines for loading and unloading ships, and conveying heavy weights by land, because all the stones were brought from Normandy. Matthew Paris speaks even in a higher strain of Walter of Coventry, who flourished towards the end of this period, when he says, that "so excellent an architect had never yet appeared, and probably never would appear, in the world." This encomium was undoubtedly too high; but it is impossible to view the remains of many magnificent fabrics, both sacred and civil, that were erected in this period, without admiring the genius of the architects by whom they were planned, and the dexterity of the workmen by whom they were executed.

In the beginning of the reign of Henry VIII. or rather towards the latter end of that of Henry VII. when brick building became common, a new kind of low pointed arch grew much in use: it was described from four centres, was very round at the haunches, and the angle at the top was very obtuse. This sort of arch is to be found in every one of Cardinal Wolsey's buildings; also at West Sheen; an ancient brick gate at Mile End, called *King John's Gate;* and in the great gate of the palace of Lambeth. From this time Gothic architecture began to decline; and was soon after supplanted by a mixed style, if one may venture to call it one; wherein the Grecian and Gothic, however discordant and irreconcileable, are jumbled together. Concerning this mode of building, Mr Warton, in his observations on Spencer's Fairy Queen, has the following anecdotes and remarks.

"Although the Roman or Grecian architecture did not begin to prevail in England till the time of Inigo Jones, yet our communication with the Italians, and our imitation of their manners, produced some specimens of that style much earlier. Perhaps the earliest was Somerset House in the Strand, built about the year 1549, by the Duke of Somerset, uncle to Edward VI. The monument of Bishop Gardiner, in Winchester cathedral, made in the reign of Mary, about 1555, is decorated with Ionic pillars. These verses of Spencer,

> ——————————Did rise
> On stately pillars, fram'd after the Doric guise.

bear an allusion to some of the fashionable improvements in building, which at this time were growing more and more into esteem. Thus also Bishop Hall, who wrote about the same time, viz 1598:

> There findest thou some stately Doricke frame,
> Or neat Ionicke work.————

But these ornaments were often absurdly introduced into the old Gothic style: as in the magnificent portico of the schools at Oxford, erected about the year 1613; where the builder, in a Gothic edifice, has affectedly displayed his universal skill in the modern architecture, by giving us all the five orders together. However, most of the great buildings of Queen Elizabeth's reign have a style peculiar to themselves both in form and finishing; where, though much of the old Gothic is retained, and great part of the new taste is adopted, yet neither predominates; while both, thus distinctly blended, compose a fantastic species, hardly reducible to any class or name. One of its Characteristics is the affectation of large and lofty windows; where, says Bacon, "you shall have sometimes fair houses so full of glass, that one cannot tell where to come to be out of the sun."

To return now to our general history, and to conclude: In the 15th and 16th centuries, when learning of all kinds began to revive, the chaste architecture of the Greeks and Romans seemed as it were to be recalled into life. The first improvements in it began in Italy, and owed their existence to the many ruins of the ancient Roman structures that were to be found in that country, from whence an improved method of building was gradually brought into the other countries of Europe: and though the Italians for a long time retained the superiority as architects over the other European nations; yet, as men of genius travelled from all quarters into Italy, where they had an opportunity of seeing the originals from whence the Italians copied, architects have risen in other nations equal, if not superior, to any that ever appeared in Italy. Of this we have a recent instance in Mr Mylne, who lately gained the prize in architecture at Rome, where it would no doubt be disputed by such natives of Italy as were best skilled in that art.

PART. I. PRINCIPLES OF ARCHITECTURE.

MANY ages must have elapsed before architecture came to be considered as a fine art. Utility was its original destination, and still continues to be its principal end. Experience, however, has taught us, that architecture is capable of exciting a variety of agreeable feelings. Of these, utility, grandeur, regularity, order, and proportion, are the chief.

23 Distinction of buildings.

Architecture being an useful as well as a fine art, leads us to distinguish buildings, and parts of buildings, into three kinds, viz. what are intended for use solely, what for ornament solely, and what for both. Buildings intended for utility solely, ought in every part to correspond precisely to that intention: the least deviation from use, though contributing to ornament, will be disagreeable; for every work of use being considered as a mean to an end, its perfection as a mean is the capital circumstance, and every other beauty in opposition is neglected as improper. On the other hand, in such things as are intended solely for ornament, as columns, obelisks, triumphal arches, &c. beauty alone ought to be regarded. The principal difficulty in architecture lies in combining use and ornament. In order to accomplish these ends, different and even opposite means must be employed; which is the reason why they are so seldom united in perfection; and hence, in buildings of this kind, the only practicable method is, to prefer utility to ornament according to the character of the building: in palaces, and ſuch buildings as admit of a variety of uſeful contrivance, regularity ought to be preferred; but in dwelling-houſes that are too ſmall for a variety of contrivance, utility ought to prevail, neglecting regularity as far as it ſtands in oppoſition to convenience.

24 Intrinſic and relative beauty.

In conſidering attentively the beauty of viſible objects, we diſcover two kinds. The firſt may be termed *intrinſic* beauty, becauſe it is diſcovered in a ſingle object, without relation to any other. The ſecond may be termed *relative* beauty, being founded on a combination of relative objects. Architecture admits of both kinds. We ſhall firſt give a few examples of *relative* beauty.

The proportions of a door are determined by the uſe to which it is deſtined. The door of a dwelling-houſe, which ought to correſpond to the human ſize, is confined to ſeven or eight feet in height and three or four in breadth. The proportions proper for a ſtable or coach-houſe are different. The door of a church ought to be wide, in order to afford an eaſy paſſage for a multitude; and its height muſt be regulated by its wideneſs, that the proportion may pleaſe the eye. The ſize of the windows ought always to be proportioned to that of the room they are deſtined to illuminate; for if the apertures be not large enough to convey light to every corner, the room muſt be unequally lighted, which is a great deformity. Steps of ſtairs ſhould likewiſe be accommodated to the human figure, without regarding any other proportion; they are accordingly the ſame in large and in ſmall buildings, becauſe both are inhabited by men of the ſame ſize.

We ſhall next conſider *intrinſic* beauty, blended with that which is *relative*. A cube itſelf is more agreeable than a parallelopipedon; this conſtantly holds in ſmall figures: but a large building in the form of a cube is lumpiſh and heavy; while a parallelopipedon, ſet on its ſmaller baſe, is more agreeable on account of its elevation: Hence the beauty of Gothic towers. But if this figure were to be uſed in a dwelling-houſe, to make way for relative beauty, we would immediately perceive that utility ought chiefly to be regarded; and this figure, inconvenient by its height, ought to be ſet on its larger baſe: the loftineſs in this caſe would be loſt; but that loſs will be more than ſufficiently compenſated by the additional convenience. Hence the form of buildings ſpread more upon the ground than raiſed in height, is always preferred for a dwelling houſe.

25 Internal diviſions of houſes.

With regard to the internal diviſions, utility requires that the rooms be rectangular, to avoid uſeleſs ſpaces. An hexagonal figure leaves no void ſpaces; but it determines the rooms to be all of one ſize, which is both inconvenient and diſagreeable for want of variety. Though a cube be the moſt agreeable figure, and may anſwer for a room of a moderate ſize; yet, in a very large room, utility requires a different figure. Unconfined motion is the chief convenience of a great room; to obtain this the greateſt length that can be had is neceſſary. But a ſquare room of large ſize is inconvenient. It removes chairs, tables, &c. at too great a diſtance from the hand, which, when unemployed, muſt be ranged along the ſides of the room. Utility, therefore, requires a large room to be a parallelogram. This figure is likewiſe beſt calculated for the admiſſion of light; becauſe, to avoid croſs-lights, all the windows ought to be in one wall; and if the oppoſite wall be at ſuch a diſtance as not to be fully lighted, the room muſt be obſcure. The height of a room exceeding nine or ten feet has little relation to utility; therefore proportion is the only rule for determining the height when above that number of feet.

26 Utility and beauty often incompatible.

Artiſts who deal in the beautiful, love to entertain the eye; palaces and ſumptuous buildings, in which intrinſic beauty may be fully diſplayed, give them an opportunity of exerting their taſte. But ſuch a propenſity is peculiarly unhappy with regard to private dwelling-houſes; becauſe, in theſe, relative beauty cannot be diſplayed to perfection without hurting intrinſic beauty. There is no opportunity for great variety of form in a ſmall houſe; and in edifices of this kind, internal convenience has not hitherto been happily adjuſted to external regularity. Perhaps an accurate coincidence in this reſpect is beyond the reach of art. Architects, however, conſtantly ſplit upon this rock; for they never can be perſuaded to give over attempting to reconcile theſe two incompatibles: how otherwiſe ſhould it happen, that of the endleſs variety of private dwelling-houſes, there ſhould not be one found that is generally agreed upon as a good pattern? the unwearied propenſity to make a houſe regular as well as convenient obliges the architect, in ſome articles, to ſacrifice convenience to regularity; and, in others, regularity to convenience; and accordingly the houſe which turns out neither regular nor convenient, never fails to diſpleaſe.

Nothing can be more evident, than that the form of a dwelling-houſe ought to be ſuited to the climate; yet no error is more common than to copy in Britain the form of Italian houſes, not forgetting even thoſe parts that are purpoſely contrived for collecting air, and for excluding the ſun: witneſs our colonnades and logios, deſigned by the Italians to gather cool air, and exclude the beams of the ſun, conveniences which the climate of Britain does not require.

27 Architecture conſidered as a fine art.

We ſhall next view architecture as one of the fine arts; which will lead us to the examination of ſuch buildings, and parts of buildings, as are calculated ſolely to pleaſe the eye. Variety prevails in the works of nature; but art requires to be guided by rule and compaſs. Hence it is, that in ſuch works of art as imitate nature, the great art is, to hide every appearance of art; which is done by avoiding regularity and indulging variety. But in works of art that are original and not imitative, ſuch as architecture, ſtrict regularity and uniformity ought to be ſtudied, ſo far as conſiſtent with utility.

28 Difference between proportions of number and quantity.

Proportion is not leſs agreeable than regularity and uniformity; and therefore, in buildings intended to pleaſe the eye, they are all equally eſſential. It is taken for granted by many writers, that in all the parts of a building there are certain ſtrict proportions which pleaſe the eye, in the ſame manner as in ſound there are certain ſtrict proportions which pleaſe the ear; and that, in both, the ſlighteſt deviations is equally diſagreeable. Others ſeem to reliſh more a compariſon between proportion in numbers and proportion in quantity; and maintain, that the ſame proportions are agreeable in both. The proportions, for example, of the num-

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Principles.

bers 16, 24, and 36, are agreeable; and so, say they, are the proportions of a room, whose height is 16 feet, the breadth 24, and the length 36. But it ought to be considered, that there is no resemblance or relation between the objects of different senses. What pleases the ear in harmony, is not the proportion of the strings of the instrument, but of the sound which these strings produce. In architecture, on the contrary, it is the proportion of different quantities that pleases the eye, without the least relation to sound. The same thing may be said of numbers. Quantity is a real quality of every body; number is not a real quality, but merely an idea that arises upon viewing a plurality of things in succession. An arithmetical proportion is agreeable in numbers: but have we from this any reason to conclude, that it must also be agreeable in quantity? At this rate, a geometrical proportion, and many others, ought also to be agreeable in both. A certain proportion may coincide in quantity and number; and amongst an endless variety of proportions, it would be wonderful if there never should be a conicidence. One example is given of this coincidence in the numbers 16, 24, and 36; but, to be convinced that it is merely accidental, we need but reflect, that the same proportions are not applicable to the external figure of a house, and far less to a column.

It is ludicrous to observe writers acknowledging the necessity of accurate proportions, and yet differing widely about them. Laying aside reasoning and philosophy, one fact universally agreed on ought to have undeceived them, that the same proportions which please in a model are not agreeable in a large building: a room 48 feet in length, and 24 in breadth and height, is well proportioned: but a room 12 feet wide and high, and 24 long, approaches to a gallery.

29 Beauty arising from proportion.

Perrault, in his comparison of the ancients and moderns, goes to the opposite extreme; maintaining, that the different proportions assigned to each order of columns are arbitrary, and that the beauty of these proportions is entirely the effect of custom. But he should have considered, that if these proportions had not originally been agreeable, they could never have been established by custom.

For illustrating this point, we shall add a few examples of the agreeableness of different proportions. In a sumptuous edifice, the capital rooms ought to be large, otherwise they will not be proportioned to the size of the building; for the same reason, a very large room is improper in a small house. But in things thus related, the mind requires not a precise or single proportion, rejecting all others; on the contrary, many different proportions are equally agreeable. It is only when a proportion becomes loose and distant, that the agreeableness abates, and at last vanishes. Accordingly, in building, rooms of different proportions are found to be equally agreeable, even where the proportion is not influenced by utility. With regard to the proportion the height of a room should bear to the length and breadth, it must be extremely arbitrary, considering the uncertainty of the eye as to the height of a room when it exceeds 16 or 17 feet. In columns, again, every architect must confess that the proportion of height and thickness varies betwixt 8 diameters and 10, and that every proportion between these two extremes is agreeable. Besides, there must certainly be a further variation of proportion, depending on the size of the column. A row of columns 10 feet high, and a row twice that height, require different proportions: The intercolumniations must also differ in proportion according to the height of the row.

Proportion of parts is not only itself a beauty, but is inseparably connected with a beauty of the highest relish, that of concord and harmony: which will be plain from what follows: A room, the parts of which are all finely adjusted to each other, strikes us not only with the beauty of proportion, but with a pleasure far superior. The length, the breadth, the height, the windows, raise each of them a separate emotion: These emotions are similar; and, though faint when separately felt, they produce in conjunction the emotion of concord or harmony, which is very pleasant. On the other hand, where the length of a room far exceeds the breadth, the mind, comparing together parts so intimately connected, immediately perceives a disagreement or disproportion which disgusts. Hence a long gallery, however convenient for exercise, is not an agreeable figure of a room.

30 Form of structures to be suited to the purposes for which they are intended.

In buildings destined chiefly or solely to please the eye, regularity and proportion are essentially necessary, because they are the means of producing intrinsic beauty. But a skilful artist will not confine his view to regularity and proportion; he will also study congruity, which is perceived when the form and ornaments of a structure are suited to the purpose for which it is appointed. Hence every building ought to have an expression suited to its destination. A palace ought to be sumptuous and grand; a private dwelling, neat and modest; a play-house, gay and splendid; and a monument, gloomy and melancholy. A heathen temple has a double destination: It is considered as a house dedicated to some divinity; therefore it ought to be grand, elevated, and magnificent: It is also considered as a place of worship; and therefore ought to be somewhat dark and gloomy, because dimness or obscurity produces that tone of mind which is favourable to humility and devotion. Columns, besides their chief destination of being supports, contribute to that peculiar expression which the destination of a building requires. Columns of different proportions serve to express loftiness, lightness, &c. as well as strength. Situation may also contribute to expression: Conveniency regulates the situation of a private dwelling-house; and the situation of a palace ought to be lofty. This leads to a question. Whether the situation, where there happens to be no choice, ought, in any measure, to regulate the form of the edifice? The connection between a great house and a neighbouring field, though not extremely intimate, demands however some congruity. It would, for example, displease us to find an elegant building thrown away upon a wild uncultivated country: congruity requires a polished field for such a building. The old Gothic form of building was well suited to the rough uncultivated regions where it was invented; but was very ill adapted to the fine plains of France and Italy.

31 Internal division of houses.

The external structure of a house leads naturally to its internal structure. A large and spacious room, which is the first that commonly receives us, is a bad contrivance in several respects. In the first place, when immediately from the open air we step into such

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a room, its ſize in appearance is diminiſhed by contraſt; it looks little, compared with the great canopy of the ſky. In the next place, when it recovers its grandeur, as it ſoon doth, it gives a diminutive appearance to the reſt of the houſe; paſſing from it, every apartment looks little. In the third place, by its ſituation it ſerves only for a waiting-room, and a paſſage to the principal apartments. Rejecting therefore this form, a hint may be taken from the climax in writing for another that appears more ſuitable: A handſome portico, proportioned to the ſize and faſhion of the front, leads into a waiting-room of a larger ſize, and this to the great room, all by a progreſſion of ſmall to great.

Grandeur is the principal emotion that architecture is capable of raiſing in the mind: it might therefore be the chief ſtudy of the artiſt, in great buildings deſtined to pleaſe the eye. But as grandeur depends partly on ſize, it is unlucky for architecture that it is governed by regularity and proportion, which never deceive the eye by making objects appear larger than they are in reality. But though regularity and proportion contribute nothing to grandeur, ſo far as that emotion depends on ſize; yet they contribute greatly to it by confining the ſize within ſuch bounds that it can be taken in and examined at one view; for when objects are ſo large as not to be comprehended but in parts, they tend rather to diſtract than ſatisfy the mind.

We ſhall next paſs to ſuch ornaments as contribute to give buildings a peculiar expreſſion. It has been doubted, whether a building can regularly admit any ornament but what is uſeful, or at leaſt has that appearance. But, conſidering the double aim of architecture as a fine, as well as an uſeful art, there is no reaſon why ornaments may not be added to pleaſe the eye, without any relation to utility. A private dwelling-houſe, it is true, and other edifices, where uſe is the chief aim, admit not regularly any ornament but what has at leaſt the appearance of uſe; but temples, triumphal arches, and other buildings intended chiefly or ſolely for ſhow, may be highly ornamented.

32 Different kinds of ornaments.

This ſuggeſts a diviſion of ornaments into three kinds, *viz.* 1. Ornaments that are beautiful without relation to uſe; ſuch as ſtatues, vaſes, baſſo or alto relievo: 2. Things in themſelves not beautiful, but poſſeſſing the beauty of utility, by impoſing on the ſpectator, and appearing to be uſeful; ſuch as blind windows: 3. Where things are beautiful in themſelves, and at the ſame time take on the appearance of uſe; ſuch as pilaſters.

With regard to the *firſt*, we naturally require that a ſtatue be ſo placed, as to be ſeen in every direction, and examined at different diſtances. Statues, therefore, are properly introduced to adorn the great ſtair that leads to the principal door of a palace, or to leſſen the void between pillars. But a niche in the external front is an improper place for a ſtatue. There is an additional reaſon againſt placing them upon the roof or top of the walls: their tickliſh ſituation gives pain, as they have the appearance of being in danger of tumbling down; beſides, we are inclined to feel from their being too much expoſed to the inclemencies of the weather. To adorn the top of the wall with a row of vaſes, is an unhappy conceit, by placing a thing, whoſe natural deſtination is utility, where it cannot have even the appearance of uſe. As to carvings upon the external ſurface of a building, termed *baſſo relievo* when flat, and *alto relievo* when prominent, all contradictory expreſſions ought be be avoided. Now, firmneſs and ſolidity being the proper expreſſions of a pedeſtal, and, on the contrary, lightneſs and delicacy of carved work, the pedeſtal, whether of a column or of a ſtatue, ought to be ſparingly ornamented. The ancients never ventured any bolder ornament than the baſſo relievo.

With reſpect to ornaments of the *ſecond* kind, it is a great blunder to contrive them ſo as to make them appear uſeleſs. A blind window, therefore, when neceſſary for regularity, ought to be ſo diſguiſed as to appear a real window: when it appears without diſguiſe, it is diſguſtful, as a vain attempt to ſupply the want of invention; it ſhows the irregularity in a ſtronger light, by ſignifying that a window ought to be there in point of regularity, but that the architect had not ſkill ſufficient to connect external regularity with internal convenience.

As to the *third*, it is an error to ſink pilaſters ſo far into the wall, as to remove totally, or moſtly, the appearance of uſe. They ſhould always project ſo much from the wall, as to have the appearance of ſupporting the entablature over them.

33 Columns.

From ornaments in general, we deſcend to a pillar, the chief ornament in great buildings. The deſtination of a pillar is to ſupport, really, or in appearance, another part termed the *entablature*. With regard to the form of a pillar, it muſt be obſerved, that a circle is a more agreeable figure than a ſquare, a globe than a cube, and a cylinder than parallelopipedon. This laſt, in the language of architecture, is ſaying, that a column is a more agreeable figure than a pilaſter; and for that reaſon it ought be preferred, when all other circumſtances are equal. Another reaſon concurs, that a column annexed to a wall, which is a plain ſurface, makes a greater variety than a pilaſter. Beſides, pilaſters at a diſtance are apt to be miſtaken for pillars; and the ſpectator is diſappointed, when, on a nearer approach, he diſcovers them to be only pilaſters.

As to the parts of a column, a bare uniform cylinder, without a capital, appears naked; and without a baſe, appears too tickliſhly placed to ſtand firm; it ought therefore to have ſome finiſhing at the top and bottom: Hence the three chief parts of a column, the ſhaft, the baſe, and the capital. Nature undoubtedly requires proportion among theſe parts, but it admits of variety of proportion. Vitruvius and ſome of the elder writers ſeem to think, that the proportions of columns were derived from the human figure, the capital repreſenting the head, the baſe the feet, and the ſhaft the body. The Tuſcan has been accordingly denominated the *Gigantic;* the Doric, the *Herculean;* the Ionic, the *Matronal;* and the Corinthian, the *Virginal;*—The Compoſite is a mixture of the Corinthian and Ionic. As to the baſe, the principle of utility interpoſes to vary it from the human figure, and to proportion it ſo to the whole, as to give the column the appearance of ſtability.

34 Whether new orders can be invented.

Among the Greeks, we find only three orders of columns, the Doric, the Ionic, and the Corinthian, diſtinguiſhed

Principles. ſtinguiſhed from each other by their deſtination as well as by their ornaments. It has been diſputed, whether any new order can be added to theſe: ſome hold the affirmative, and give for inſtances the Tuſcan and Compoſite; others maintain, that theſe properly are not diſtinct orders, but only the original orders with ſome ſlight variation. The only circumſtances that can ſerve to diſtinguiſh one order from another, are the form of the column, and its deſtination. To make the firſt a diſtinguiſhing mark, without regard to the other, would multiply orders without end. Deſtination is more limited, and it leads us to diſtinguiſh three kinds of orders; one plain and ſtrong, for the purpoſe of ſupporting plain and maſſy buildings; one delicate and graceful, for ſupporting buildings of that character; and between theſe, a third, for ſupporting buildings of a mixed nature. So that, if deſtination alone is to be regarded, the Tuſcan is of the ſame order with the Doric, and the Compoſite with the Corinthian.

The ornaments of theſe three orders ought to be ſuited to the purpoſes for which they are intended. Plain and ruſtic ornaments would not be a little diſcordant with the elegance of the Corinthian order, and ſweet and delicate ornaments not leſs with the ſtrength of the Doric.

35 Rules regarding building in general.

With reſpect to buildings of every kind, one rule, dictated by utility, is, that they be firm and ſtable. Another, dictated by beauty, is, that they alſo appear ſo to the eye: for every thing that appears tottering, and in hazard of tumbling down, produceth in the ſpectator the painful emotion of fear, inſtead of the pleaſing emotion of beauty; and accordingly it ſhould be the great care of the artiſt, that every part of his edifice appear to be well ſupported. Some have introduced a kind of conceit in architecture, by giving parts of buildings the appearance of falling; of this kind is the church of St Sophia in Conſtantinople; the round towers in the uppermoſt ſtories of Gothic buildings is in the ſame falſe taſte.

The moſt conſiderable ornaments uſed in architecture are the five orders of columns, pediments, arches, balluſters, *&c.* of which in the following chapters.

Chap. I. *Of the Orders of Architecture.*

An **Order** conſiſts of two principal members, the **Column** and the **Entablature**; each of which is compoſed of three principal parts. Thoſe of the Column are, the *Baſe*, the *Shaft*, and the *Capital*; and thoſe of the Entablature are, the *Architrave*, the *Frize*, and the *Cornice*. All theſe are ſubdivided into many leſſer parts, whoſe number, form, and dimenſions, characteriſe each order, and expreſs the degree of ſtrength, delicacy, richneſs, or ſimplicity peculiar to it.

36 Parts of an order divided into two claſſes.

The parts that compoſe an order may be diſtributed into two different claſſes. In the *firſt* may be ranged all that have any analogy to the primitive huts, and repreſent ſome part that was neceſſary in their conſtruction. Such are the ſhaft of the column, with the plinth of its baſe, and the abacus of its capital; likewiſe the architrave and triglyphs, the mutules, modilions, or dentils, which all of them repreſent the rafters, or ſome other pieces of timber uſed to ſupport the covering; and the corona, repreſenting the beds of materials that compoſed the covering. All theſe may properly be diſtinguiſhed by the name of *eſſential members*. The ſubſervient parts, contrived for the uſe or ornaments of the former, and commonly called *mouldings*, may conſtitute the *ſecond* claſs.

There are eight regular mouldings in ornamenting columns: the fillet, liſtel, or ſquare; the aſtragal, or bead; the torus, or tore; the ſcotia, mouth, or caſement; the echinus, ovolo, or quarter-round; the inverted cyma, talon, or ogee; the cyma, cyma recta, or cymation; the cavetto, or hollow. The names of theſe allude to their forms, and their forms are adapted to the purpoſes for which they are intended. See Plate XL.

The ovolo and talon, as they are ſtrong at the extremities, are fit for ſupporters; the cyma and cavetto, though improper for ſupports, ſerve for coverings to ſhelter other members; the torus and aſtragal, being ſhaped like ropes, are intended to bind and fortify the parts with which they are connected: But the uſe of the ſcotia and fillet is only to ſeparate and diſtinguiſh the other mouldings, to give a graceful turn to the profile, and to prevent the confuſion which would ariſe from joining ſeveral curved members together.

There are various methods of deſcribing the contours of mouldings; but the ſimpleſt and beſt is to form them of quadrants of circles.

37 Profile, what.

An aſſemblage of what are called eſſential parts and mouldings is termed a *profile*. The moſt perfect profiles are ſuch as are compoſed of few mouldings, varied in form and ſize; and ſo diſpoſed, that the ſtraight and curved ones ſucceed each other alternately. When ornaments are employed in mouldings, ſome of them ſhould be left plain, in order to give a proper repoſe: For when all are ornamented, the figure of the profile is loſt.

38 Diminution of columns.

Columns, in imitation of trees, from which they drew their origin, are tapered in their ſhafts. In the antiques the diminution is variouſly performed; beginning ſometimes from the foot of the ſhaft, and at others from one-quarter, or one-third of its height; the lower part being perfectly cylindrical. The former of theſe was moſt in uſe amongſt the ancients, and, being the moſt natural and graceful, ought to have the preference, though the latter hath been more univerſally practiſed by modern artiſts.

The firſt architects, ſays Mr Auzoult, probably made their columns in ſtraight lines, in imitation of trees; ſo that their ſhaft was a fruſtum of a cone: but finding this form abrupt and diſagreeable, they made uſe of ſome curve, which, ſpringing from the extremities of the ſuperior and inferior diameters of the column, ſwelled beyond the ſides of the cone, and by that means gave a more pleaſing figure to the contour.

Vitruvius, in the ſecond chapter of his third book, mentions this practice, but in ſo obſcure and curſory a manner, that his meaning hath not been underſtood; and ſeveral of the modern architects, intending to conform themſelves to the doctrine have made the diameters of their columns greater in the middle than at the foot of the ſhaft. Leon Baptiſta, Alberti, and others of the Florentine and Roman architects, have carried this to a very great exceſs; for which they have

Fig. 2. The second sort of Huts

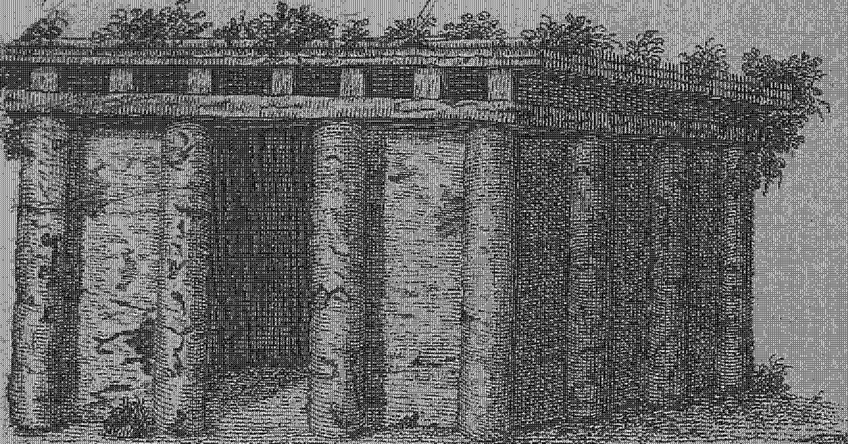


Fig. 1. The first sort of Huts

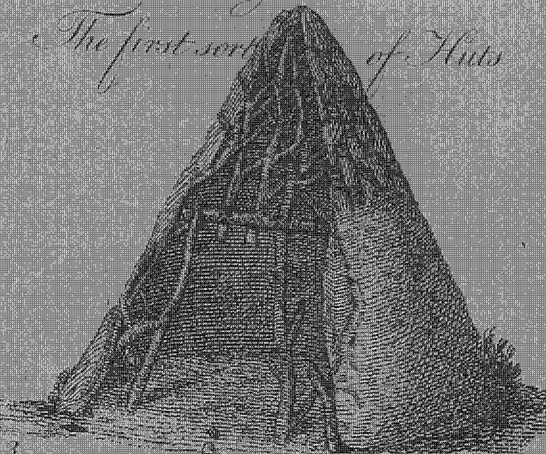


Fig. 4. Origin of the Corinthian Order

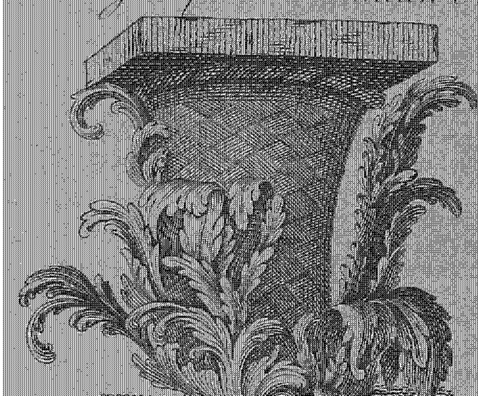
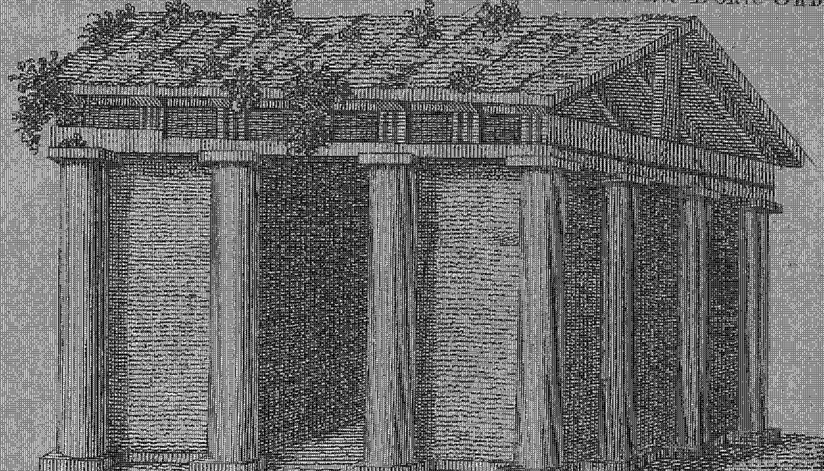


Fig. 3. The third sort of huts which gave rise to the Doric Order



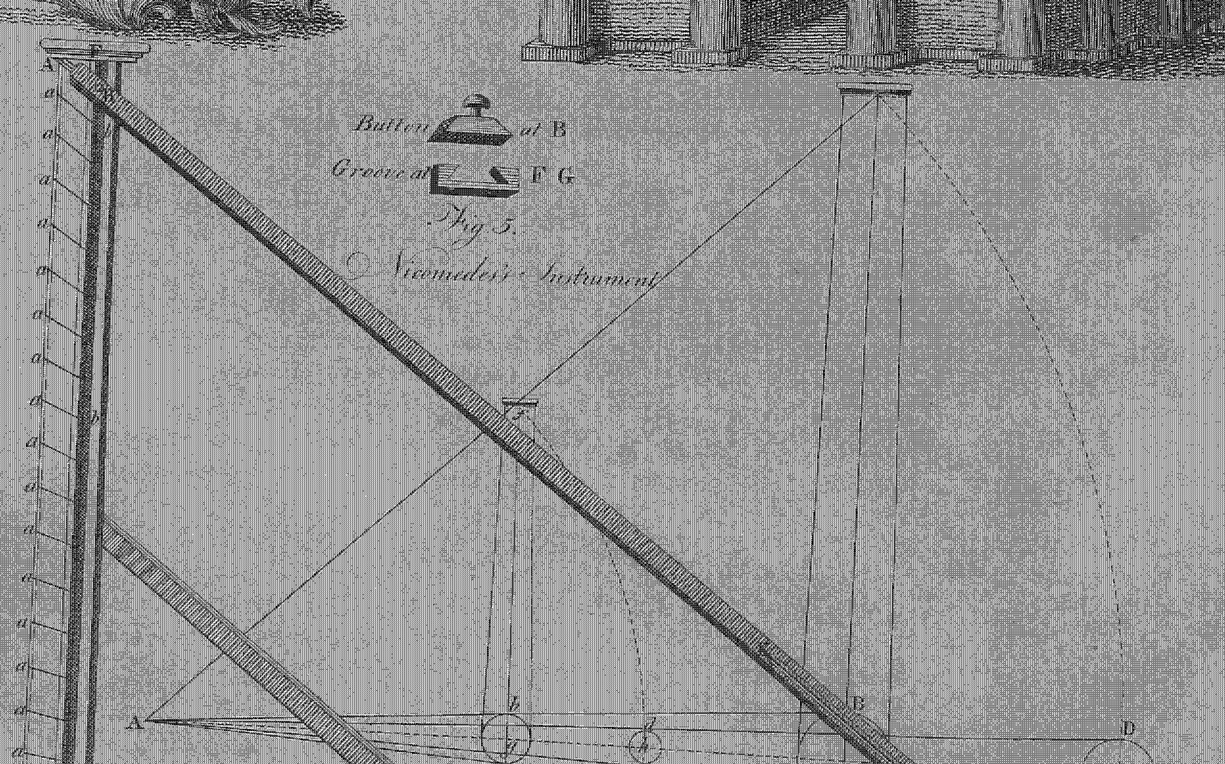
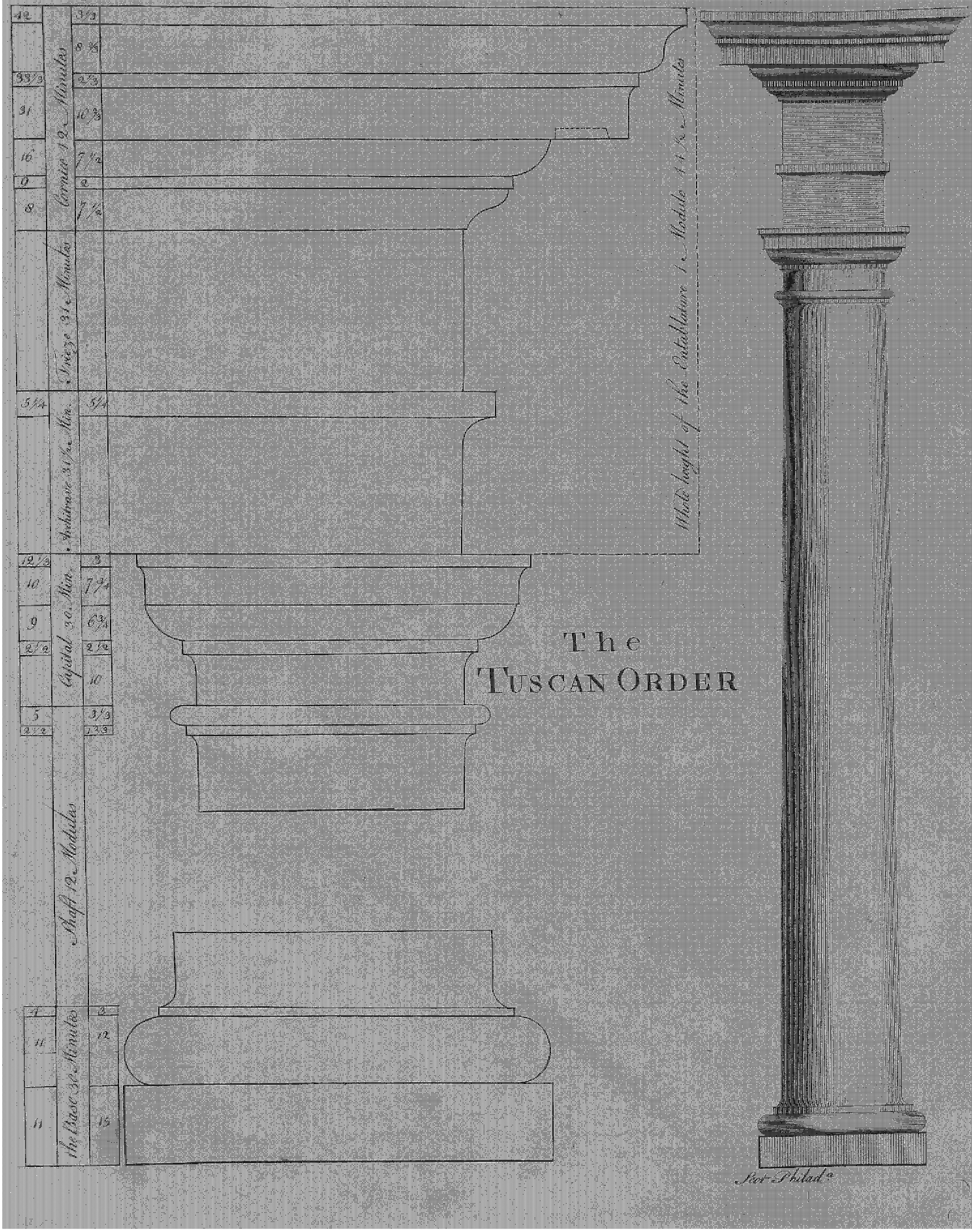


Fig. 5. Nicomedes's Instrument



The TUSCAN ORDER

have been juſtly blamed, as it is neither natural, reaſonable, nor beautiful.

Monſieur Auzoult obſerves, that a column, ſuppoſing its ſhafts to be the fruſtum of a cone, may have an additional thickneſs in the middle, without being ſwelled there beyond the bulk of its inferior parts; and ſuppoſes the addition mentioned by Vitruvius to ſignify nothing but the increaſe towards the middle of the column, occaſioned by changing the ſtraight line, which at firſt was in uſe, for a curve.

This ſuppoſition is extremely juſt, and founded on what is obſerved in the works of antiquity; where there is no inſtance of columns thicker in the middle than at the bottom, though all have the ſwelling hinted at by Vitruvius, all of them being terminated by curves; ſome granite columns excepted, which are bounded by ſtraight lines; a proof, perhaps, of their antiquity, or of their having been wrought in the quarries of Egypt by bungling and unſkilful workmen.

Monſieur Blondel, in his book, entitled, *Reſolution des quatre principaux problemes d' Architecture*, teaches various manners of diminiſhing columns; the beſt and ſimpleſt of which is by means of the inſtrument which Nicomedes invented to deſcribe the the firſt conchoid: for this, being applied at the bottom of the ſhaft, performs at one ſweep both the ſwelling and the diminution; giving ſuch a graceful form to the column, that it is univerſally allowed to be the moſt perfect practice hitherto diſcovered. The columns in the Pantheon, accounted the moſt beautiful among the antiques, are made in this manner; as appears by the exact meaſures of one of them to be found in Deſgodet's antiquities of Rome.

36 Vignola's method.

To give an accurate idea of the operation, it will be neceſſary firſt to deſcribe Vignola's method of diminution, on which it is grounded. "As to this ſecond method, ſays Vignola, it is a diſcovery of my own; and although it be leſs known than the former, it will be eaſily comprehended by the figure.

Pl.XXXVI Having therefore determined the meaſures of your column, (that is to ſay, the height of the ſhaft, and its inferior and ſuperior diameters), draw a line indefinitely from C through D, perpendicular to the axis of the column: this done, ſet off the diſtance C D, which is the inferior ſemi-diameter, from A, the extreme point of the ſuperior ſemi-diameter, to B, a point in the axis; then from A, through B, draw the line A B E, which will cut the indefinite line C D in E; and, from this point of interſection E, draw thro' the axis of the column any number of rays as E b a, on each of which, from the axis towards the circumference, ſetting off the interval C D, you may find any number of points, a, a, a, through which if a curve be drawn, it will deſcribe the ſwelling and diminution of the column."

40 Nicomedes'sinſtrument.

Though this method be ſufficiently accurate for practice, eſpecially if a conſiderable number of points be found, yet, ſtrictly ſpeaking, it is defective; as the curve muſt either be drawn by hand, or by applying a flexible ruler to all the points; both of which are liable to variations. Blondel therefore, to obviate this objection, (after having proved the curve paſſing from A to C through the points a a, to be of the ſame nature with the firſt conchoid of the ancients), employed the inſtrument of Nicomedes to deſcribe it; the conſtruction of which is as follows:

Having determined, as above, the length of the ſhaft, with the inferior and ſuperior diameters of the column, and having likewiſe found the length of the line C D E, take three rulers, either of wood or metal, as F G, I D, and A H; of which let F G and I D be faſtened together at right angles in G. Cut a dove-tail groove in the middle of F G, from top to bottom; and at the point E on the ruler I D (whoſe diſtance, from the middle of the groove in F G, is the ſame as that of the point of interſection from the axis of the column) fix a pin; then on the ruler A H ſet off the diſtance A B, equal to C D the inferior ſemidiameter of the column, and at the point B fix a button, whoſe head muſt be exactly fitted to the groove made in F G, in which it is to ſlide; and, at the other extremity of the ruler A H, cut a ſlit or canal from H to K, whoſe length muſt not be leſs than the difference of length between E B and E D, and whoſe breadth muſt be ſufficient to admit the pin fixed at E, which muſt paſs through the ſlit, that the ruler may ſlide thereon.

The inſtrument being thus completed, if the middle of the groove, in the ruler F G, be placed exactly over the axis of the column, it is evident that the ruler A H, in moving along the groove, will with the extremity A deſcribe the curve A a a C; which curve is the ſame as that produced by Vignola's method of diminution, ſuppoſing it done with the utmoſt accuracy; for the interval A B, a b, is always the ſame; and the point E is the origin of an infinity of lines, of which the parts B A, ba, ba, extending from the axis to the circumference, are equal to each other and to D C. And if the rulers be of an indefinite ſize, and the pins at E and B be made to move along their reſpective rulers, ſo that the intervals A B and D E may be augmented or diminiſhed at pleaſure, it is likewiſe evident that the ſame inſtrument may be thus applied to columns of any ſize.

In the remains of antiquity the quantity of the diminution is various; but ſeldom leſs than one-eighth of the inferior diameter of the column, nor more than one-ſixth of it. The laſt of theſe is by Vitruvius eſteemed the moſt perfect. 41 Quantity of diminution

Of the Tuscan Order.

This is the moſt ſolid and ſimple of all the orders. It is compoſed of few parts, devoid of ornaments, and ſo maſſy, that it ſeems capable of ſupporting the heavieſt burden. There are no remains of a regular Tuſcan order among the antiques: the doctrine of Vitruvius concerning it is obſcure; and the profiles of Palladio, Scamozzi, Serlio, de l'Orme, and Vignola, are all imperfect. 42 Plate XXXVII.

The height of the Tuſcan column is 14 modules, or ſemi-diameters, each conſiſting of 30 minutes; and that of the whole entablature $3\frac{1}{2}$ modules; which being divided into 10 equal parts, three of them are for the height of the architrave, three for the frize, and the remaining four for the cornice: The capital is one module; the baſe, including the lower cincture of the shaft, is likewise one module; and the shaft, with its upper cincture and astragal, 12 modules.

These are the general dimensions of the order; the particular dimensions may be learned by inspection of the plates.

In the remains of antiquity, the quantity of diminution at the top of the Tuscan column is various; but seldom less than one-eighth, nor more than one-sixth, of the inferior diameter of the column. The last of these is generally preferred; and Chalmers and others make the same diminution in all columns, without regard to their order.

Of the Doric Order.

43 Plate XXXVIII.

This order is next in strength to the Tuscan; and, being of a grave, robust, and masculine aspect, is by Scamozzi called the *Herculean*. As it is the most ancient of all the orders, it retains more of the structure of the primitive huts than any of the rest; the triglyphs in its frize representing the ends of the joists, and the mutules in its cornice representing the rafters.

The height of the Doric column, including its capital and base, is 16 modules, and the height of the entablature four; the latter of which being divided into eight parts, two of them are for the architrave, three for the frize, and three for the cornice.

In most of the antiques, the Doric column is executed without a base. Vitruvius likewise makes it without one; the base, according to him, having been first employed in the Ionic order, in imitation of the sandal of a woman's foot. Scamozzi blames this practice, and most of the modern architects are of his opinion.

44 Ornaments of the frize.

In the profile of the theatre of Marcellus, the frize is enriched with husks and roses; the architrave consists only of one fascia and a fillet; the drops are conical; the metope is enriched with a bull's skull, adorned with a garland of beads, in imitation of those on the temple of Jupiter Tonans, at the foot of the Capitol. In some antique fragments, and in a great many modern buildings, the metopes are alternately adorned with ox-skulls and pateras. But they may be filled with any other ornaments, according to the destination of the building.

The Ionic Order

45 Plate XXXIX.

Is of a more slender make than the Doric or Tuscan; its appearance is simple, yet graceful and majestic; its ornaments are few; so that it has been compared to a sedate matron, in decent, rather than magnificent, attire.

Among the ancients, the form of the Ionic profile appears to have been more positively determined than that of any other order; for, in all the antiques at Rome (the temple of Concord excepted), it is exactly the same.

The modern artists have likewise been unanimous in their opinions; all of them, excepting Palladio and his imitators, having employed the dentil, cornice, and the other parts of the profile, nearly as they are found in the Collifeum, the temple of Fortune, and the theatre of Marcellus.

The height of the Ionic column is 18 modules, and that of the entablature $4\frac{1}{2}$, or one quarter of the height of the column, as in the other orders, which is a trifle less than in any of the antique Ionics. In all the antiques, the base is Attic; and the shaft of the column may either be plain, or fluted with 24 flutings, or 20 only, as in the temple of Fortune. The plan of the flutings may be a trifle more than a semicircle, as in the forum of Nerva, because they then appear more distinct. The fillets, or intervals between them, must not be broader than one-third of the breadth of the fluting, nor narrower than one-fourth. The ornaments of the capital must correspond with the flutings of the shaft; and there must be an ove above the middle of each fluting. The volutes ought to be traced according to Mr Goldman's method, which is as follows:

46 Method of drawing volutes.

Plate XL. fig. 9. Draw the cathetus F C, whose length must be 15 minutes, or one-fourth of a module; and, from the point C, describe the eye of the volute A E B D, of which the diameter is to be $6\frac{2}{3}$ minutes; divide it into four equal sectors by the diameters A B, D E. Bisect the radii C A, C B, in 1 and 4; and on the line 1, 4, construct a square 1, 2, 3, 4. From the centre C, to the angles 2, 3, draw the diagonals C 2, C 3, and divide the side of the square 1, 4, into 6 equal parts, at 5, 9, C, 12, 8. Then through the points 5, 9, 12, 8, draw the lines 5, 6, 9, 10, 12, 11, 8, 7, parallel to the diameter E D, which will cut the diagonals in 6, 7, 10, 11; and the points 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, will be the centres of the volute. From the first centre 1, with the distance 1 F, describe the quadrant F G; from the second centre 2, with the distance 2 G, describe the quadrant G H; and, continuing the same operation from all the 12 centres, the contour of the volute will be completed.

Fig. 10. The centres for describing the fillet are found in this manner. Construct a triangle, of which the side A F is equal to the part of the cathetus contained between A F and the side F V, equal to C 1; place the distance F S from F towards A, equal to F S the breadth of the fillet, and through the point S draw the line S T, which will be to C 1 in the same proportion as A S is to A F; place this line on the diameter of the eye A B; divide it into three equal parts; and, through the points of division, draw lines parallel to the diameter E D, which will cut the diagonals C 2, C 3, and you will have twelve new centres, from whence the interior contour of the fillet may be described, in the same manner as the exterior one was from the first centres.

Of the Corinthian Order.

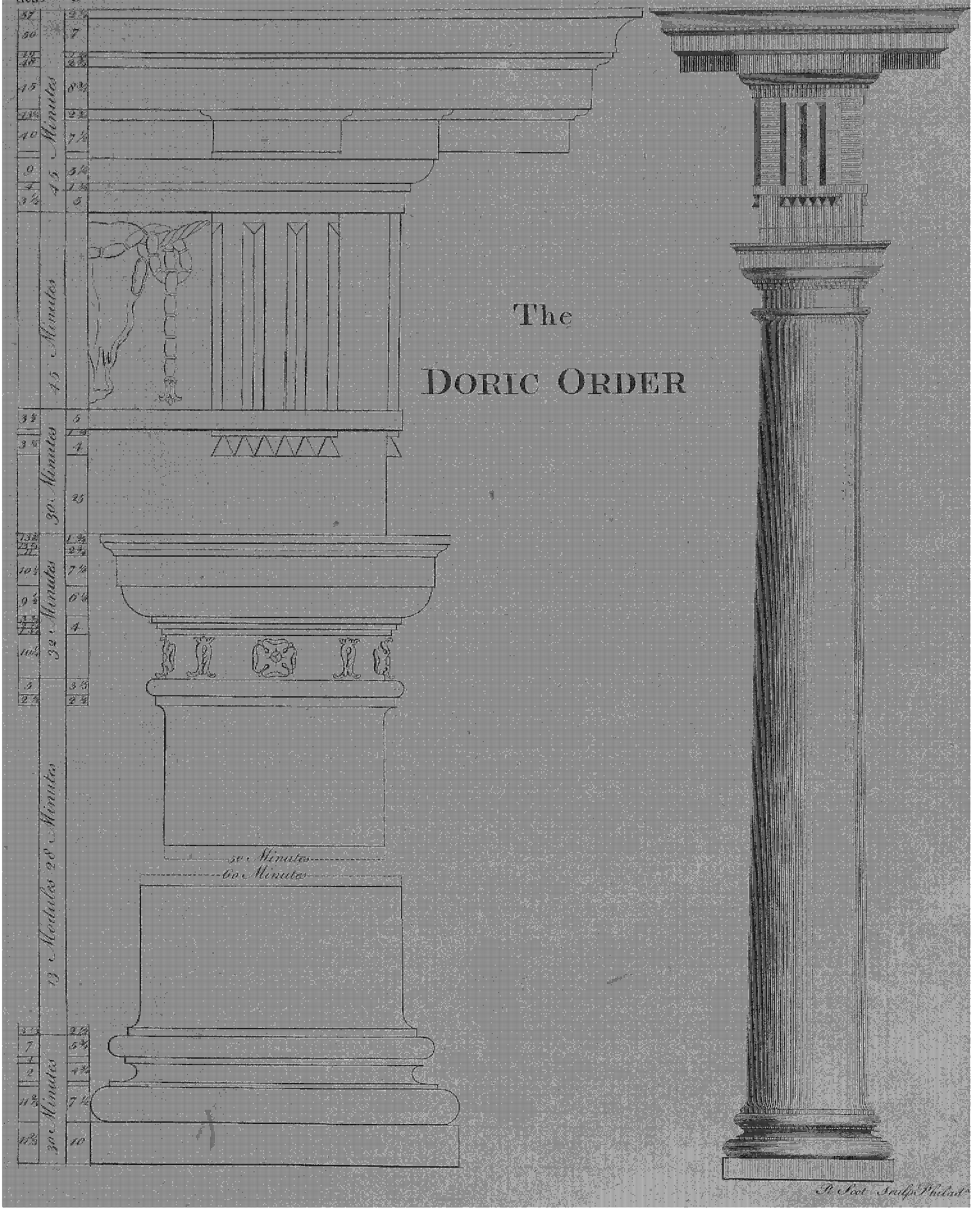
47 Plate XLI.

The proportions of this order are extremely delicate. It is divided into a great variety of members, and enriched with a profusion of ornaments. Scamozzi calls it the *virginal order*; and indeed it has all the delicacy in its make, and all the delicacy in its dress, peculiar to young girls.

The most perfect model of the Corinthian order is generally allowed to be in the three columns in the Campo Vaccino at Rome, the remains, as it is thought, of the temple of Jupiter Stator.

The

DORIC ORDER



R. Scot Sculp. Philad.

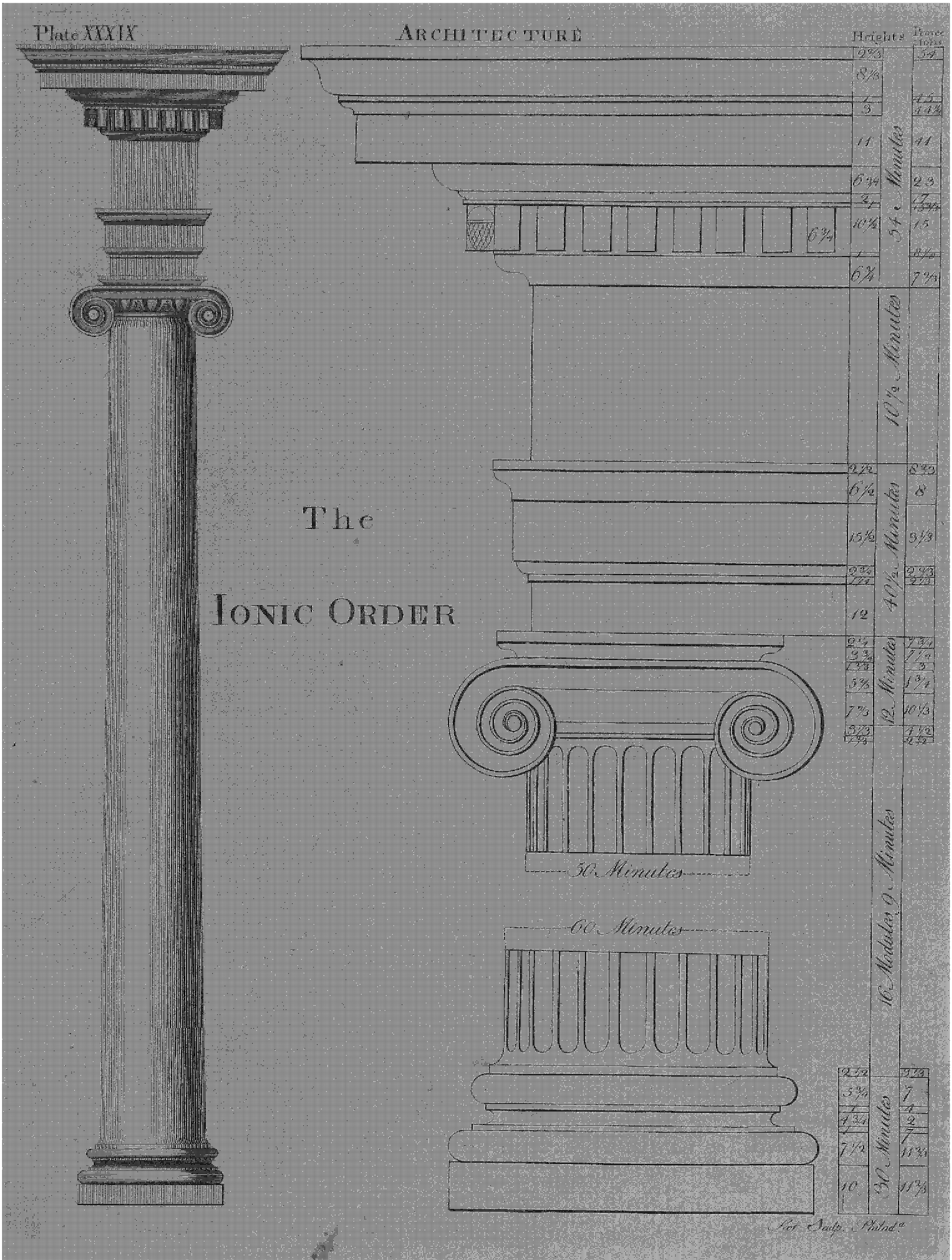
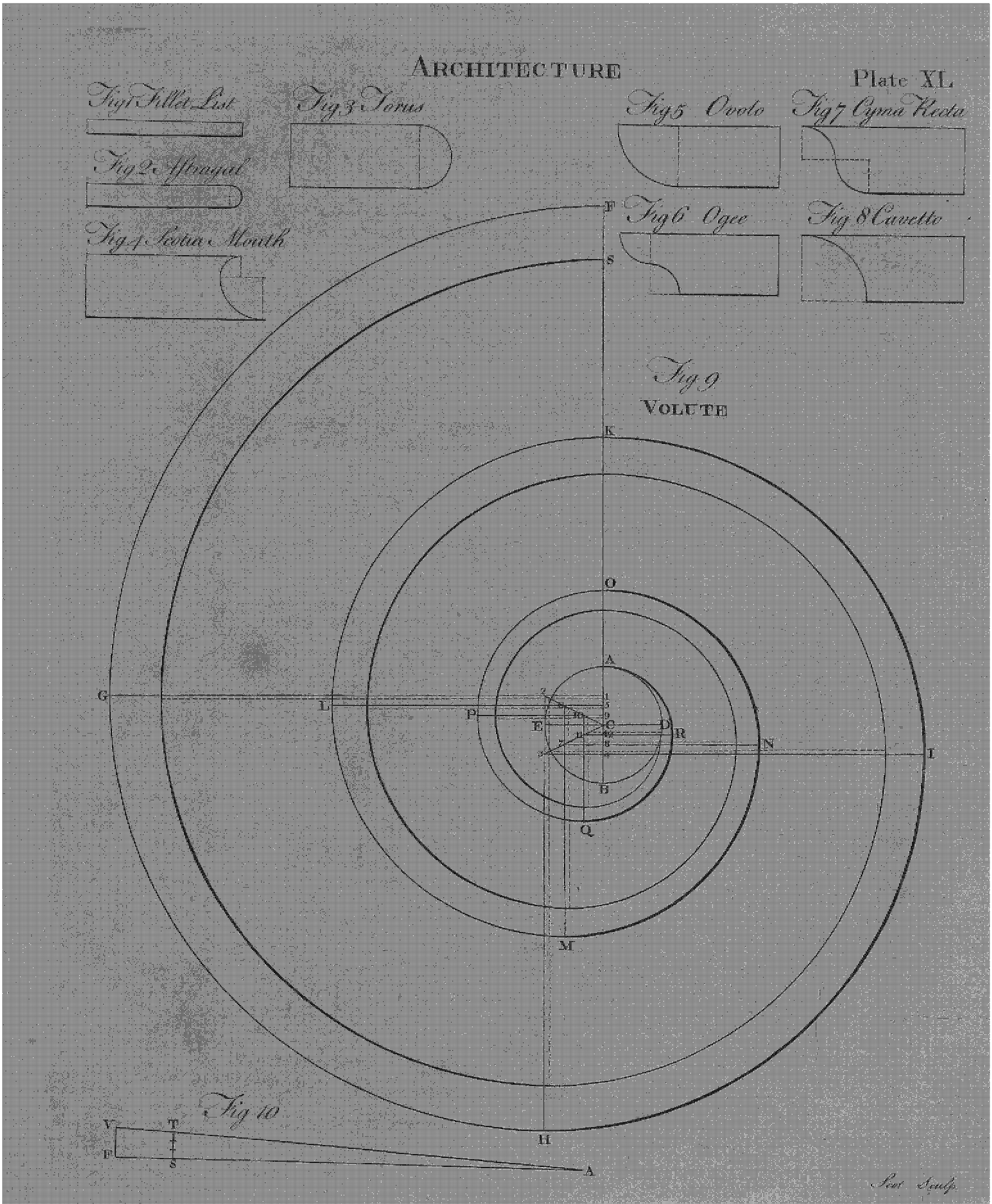
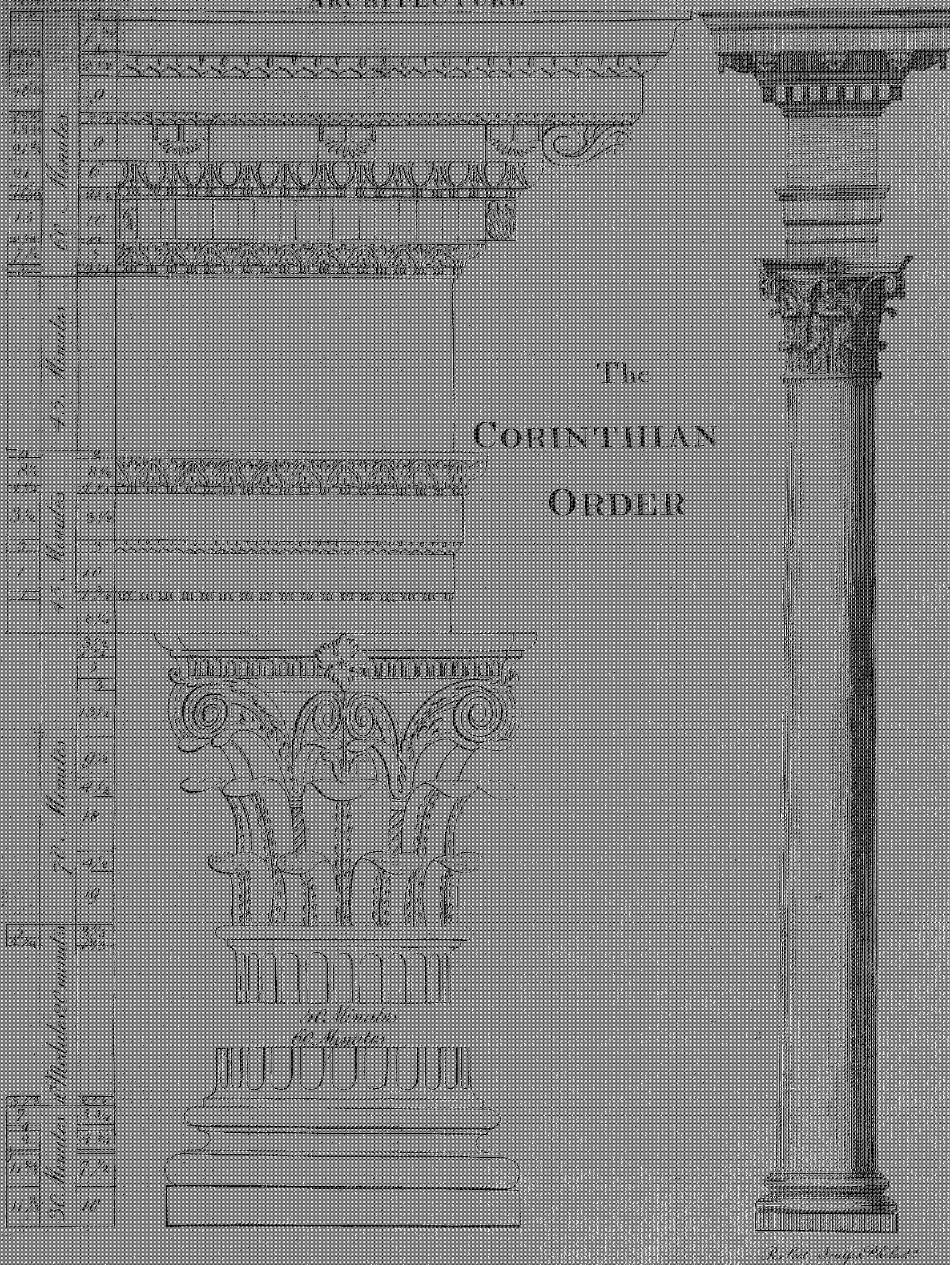


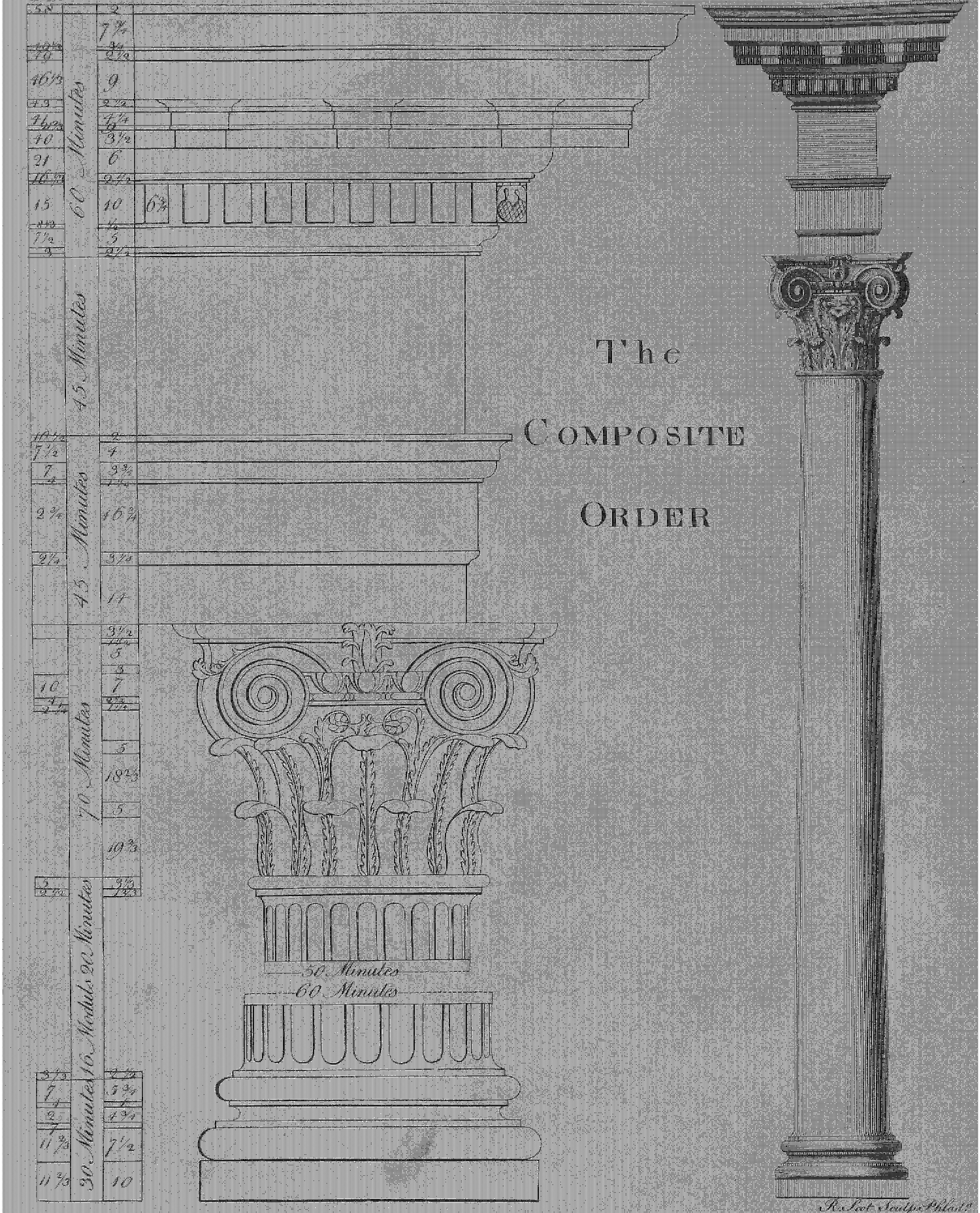
Plate XXXIX
ARCHITECTURE
Heights
The
Ionic Order
54 Minutes
40½ Minutes
12 Minutes
50 Minutes
60 Minutes
30 Minutes


ARCHITECTURE
Plate XL
Fig 1 Fillet List
Fig 2 Astragal
Fig 3 Torus
Fig 4 Scotia Mouth
Fig 5 Ovolo
Fig 6 Ogee
Fig 7 Cyma Recta
Fig 8 Cavetto
Fig 9
VOLUTE
Fig 10
Scot Sculp



The
CORINTHIAN
ORDER

R. Scot Sculp. Philad.a

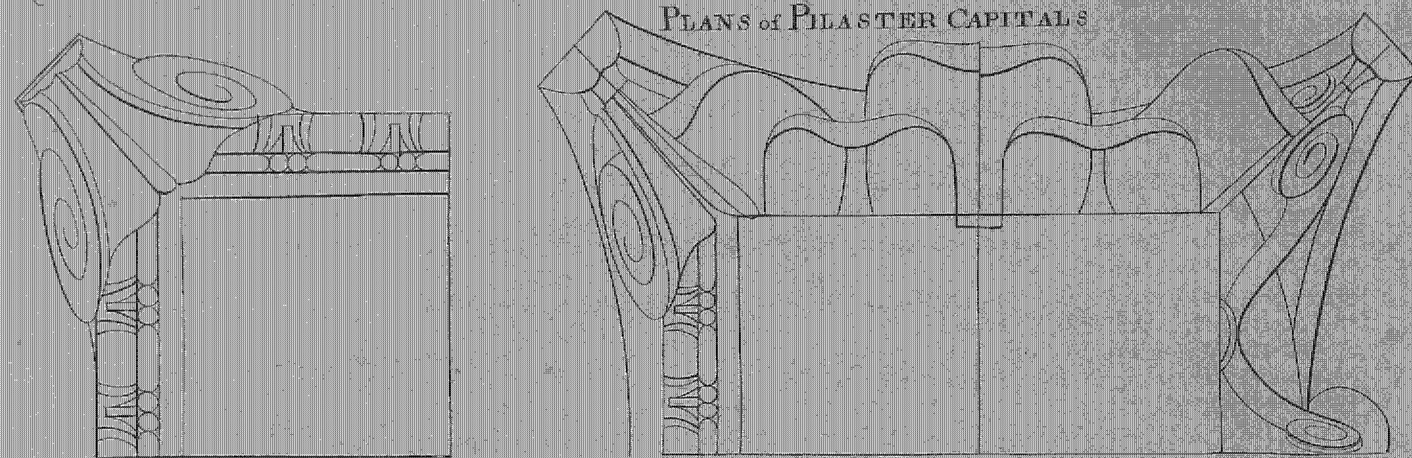


The Composite Order

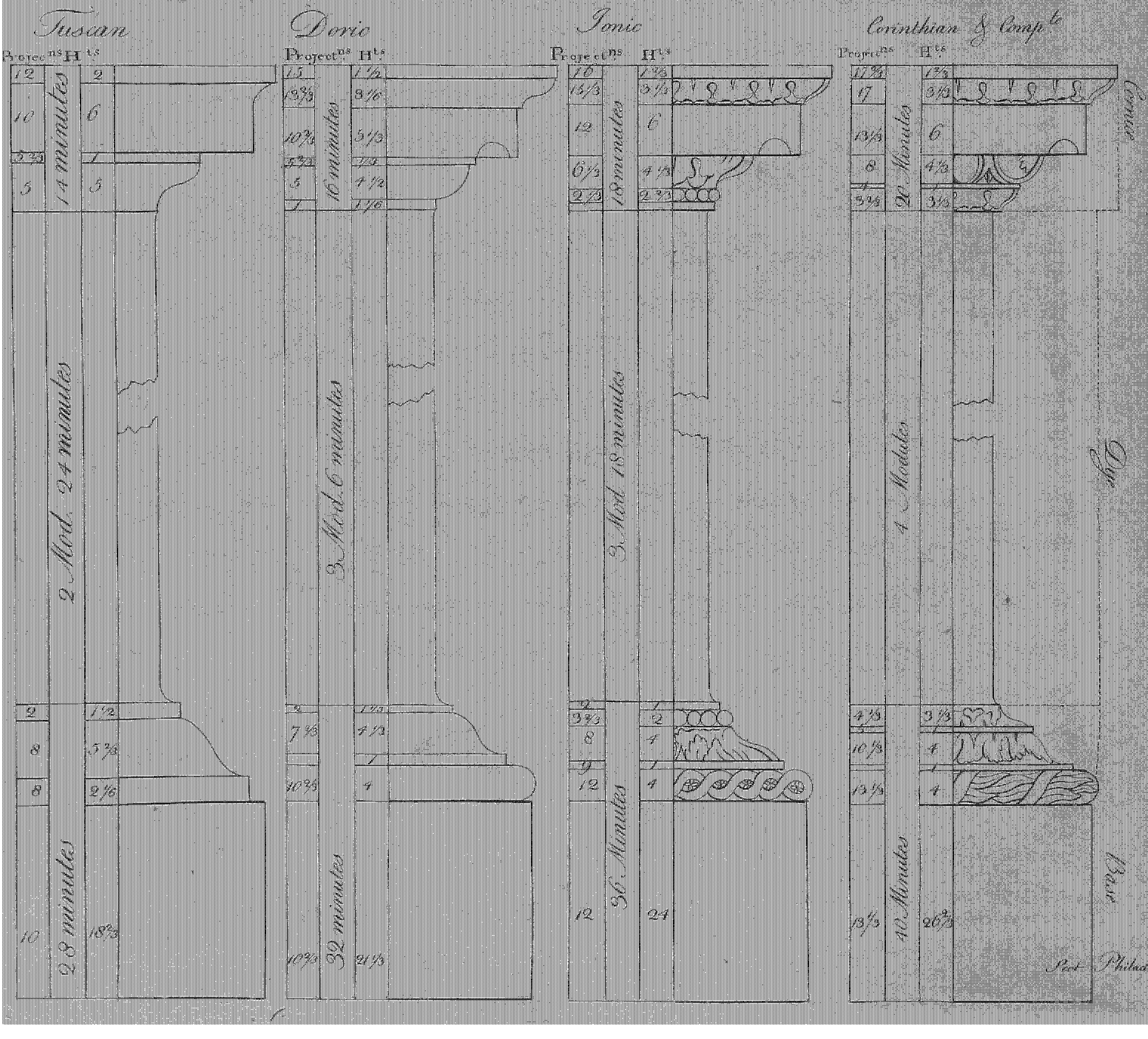
ARCHITECTURE

Plate XLIII

PLANS of PILASTER CAPITALS



PEDESTALS



Principles. The Corinthian column ſhould be 20 modules high, and the entablature 5; which proportions are a medium between thoſe of the Pantheon and the three columns. The baſe of the column may be either Attic or Corinthian: They are both beautiful. If the entablature be enriched, the ſhaft may be fluted. The fluting may be filled, to one-third of their height, with cabblings, as in the inſide of the Pantheon; which will ſtrengthen the lower part of the column, and make it leſs liable to injury.

In moſt of the antiques at Rome, the capital of this order is enriched with olive-trees; the acanthus being ſeldom employed but in the Compoſite. De Cordemoy, however, prefers the acanthus.

The divſions of the entablature bear the ſame proportions to each other, as the Tuſcan, Ionic, and Compoſite orders.

48 Pl. XLII.

The Composite

Is, ſtrictly ſpeaking, only a ſpecies of the Corinthian; and therefore retains, in a great meaſure, the ſame character.

49 Different kinds of ornaments.

It does not appear, that the ancients affected any particular form of entablature to this order. Sometimes the cornice is entirely plain, as in the temple of Bacchus; at others, as in the arch of Septimius Severus, it is enriched with dentils differing very little from the Ionic; and in the arch of Titus, there are both dentils and modilions; the whole form of the profile being the ſame with the Corinthian, as executed in the antiques at Rome.

The modern architects have varied more in this than in any other order, each following the bent of his own fancy.

The height of the Compoſite column, and parts of the entablature, is the ſame with that of the Corinthian. The foot of the leaves of the capital ought not to project beyond the upper part of the ſhaft. The different bunches of leaves ſhould be ſtrongly marked; the ſprigs which ariſe between the upper ones ſhould be kept flat upon the vaſe; and the ornaments of the volutes muſt not project beyond the fillets that incloſe them.

50

Chap. II. *Of Pilaſters.*

These differ from columns only in their plan; which is a ſquare, as that of columns is round. Their baſes, capitals, and entablatures, have the ſame parts, with the ſame heights and projections, as thoſe of columns: they are alſo diſtinguiſhed in the ſame manner, by the names of Tuſcan, Doric, Ionic, Corinthian, and Compoſite.

The column is undoubtedly more perfect than the the pilaſtre. However, they may be employed with great propriety on many occaſions. Some authors declaim againſt pilaſters, becauſe, according to them, they do not admit of diminution. But this is a miſtake; there are many inſtances, in the remains of antiquity, of their being diminiſhed. Scamozzi always gave his pilaſters the ſame diminution as his columns: Palladio and Inigo Jones have likewiſe diminiſhed them in many of their buildings.

51 Pilaſters where uſeful.

Pilaſters are employed in churches, galleries, halls, and other interior decorations, to ſave room; for, as they ſeldom project beyond the ſolid wall above one quarter of their diameter, they do not occupy near ſo much ſpace as columns. They are likewiſe uſed in exterior decorations; ſometimes alone, inſtead of columns on account of their being leſs expenſive; and ſometimes they accompany columns, being placed behind them to ſupport the architraves, where they enter the building, as in the Pantheon at Rome; or, in the ſame line with them, to fortify the angles, as in the portico of Septimius. Principles.

When pilaſters are uſed alone, they ſhould project one-quarter of their diameter beyond the walls. When placed behind columns, eſpecially if they be very near them, they need not project above one-eighth of their diameter. But, when placed on a line with columns, their projection muſt be regulated by that of the columns; and, conſequently it can never be leſs than a ſemidiameter, even when the columns are engaged as much as poſſible.

52 How ornamented.

The ſhafts of pilaſters are frequently adorned with flutings, in the ſame manner as thoſe of columns; the plan of which may be a trifle more than a ſemicircle: their number muſt be ſeven on each face, which make them nearly of the ſame ſize with thoſe of columns. The intervals, or fillets, muſt either be one-third or one-fourth of the fluting in breadth.

The capitals of pilaſters are profiled nearly in the ſame manner as thoſe of columns. Pl. XLIII.

Chap. III. *Of Attics.* 53

These very properly follow the pilaſters; being nothing more than ſquare pillars with their cornices. They had their origin in Athens, where it was for many ages a rule in building to conceal the roof. For this purpoſe, nothing ſerved ſo well as a kind of low or little order ranged in a continued line, ſingly, or with the interruption of balluſters; which riſing above the reſt of the work and before the roof, hid it perfectly, and placed ſomething agreeable in view. The place of Atties, therefore, is at the uppermoſt extremity of a building, to which they ſerve as a crown, or very properly make a finiſhing for the other orders when they have been uſed in the ſtructure. They muſt never ſtand under any thing except ſuch ornaments as are placed at the very top. Theſe Attics ſhould never exceed in height one-third of the height of the order on which they are placed, nor be leſs than one-quarter of it. The baſe, dye, and cornice, of which they are compoſed, may bear the ſame proportions to each other as thoſe of pedeſtals do; and the baſe and cornice may be compoſed of the ſame mouldings as thoſe pedeſtals. Sometimes the Attic is continued throughout; at others, it projects, and forms a pilaſter over each column of the order. The breadth of this pilaſter is ſeldom made narrower than the upper diameter of the column below it, and never broader. Its projection may be equal to one-quarter of its breadth.

Chap. IV. *Of Perſians, Caryatides, and Termini.* 54

Besides columns and pilaſters, it is ſometimes cuſtomary to employ repreſentations of the human figure, to ſupport entablatures in buildings. The male figures are called *Perſians;* and the female, *Carians,* or *Caryatides.*

The

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55 Origin of Persians.

The *Persians* are so called from a victory gained over the Persians by Pausanias, who having brought home spoils and trophies to the Athenians, they fixed upon Persian figures for those which should support entablatures, and thus kept in mind that there were once Persian slaves in Athens. To represent these conquered people in the lowest state possible, they loaded them with the heaviest entablature, *viz.* that of the Doric order. In process of time, however, other figures besides that of Persians were introduced, and other entablatures put over them; but the name was still retained.

56 Of Caryatides.

The proper Caryatides are women dressed in long robes, after the Asiatic manner; and the origin of the device was as follows.—The Carians had been long at war with the Athenians; but being at length totally vanquished, their wives were led away captives; and, to perpetuate the memory of this event, trophies were erected, in which figures of women dressed in the Caryatic manner, were used to support entablatures like the Persians; and though other female figures were afterwards used in the same manner, the name of *Caryatides* was always retained.

The ancients made frequent use of Persians and Caryatides, and delighted in diversifying them a thousand ways. The modern artists have followed their example; and there is a great variety of compositions of this kind to be met with in different parts of Europe.

Indecent attitudes, distorted features, and all monstrous productions, ought to be avoided, of which there are many examples in Gothic buildings. On the contrary, the attitudes should be simple and graceful, the countenance always pleasing, though varied and strongly marked agreeable to the nature of the object represented.

57 Their proportions, &c.

The Caryatides, or female figures, should never much exceed the human size. But the Persians, or male figures, may be of any size; and the larger the better, as they will strike the beholder with the greater awe and astonishment. Persians may be used with propriety in arsenals, galleries of armour, &c. under the figures of captives, heroic virtues, &c. Their entablature ought to be Doric, and bear the same proportion to them as to columns of the same height. The entablature for Caryatides ought to be either Ionic or Corinthian, according as the character of the figures is more or less delicate.

58 Termini.

Termini are sometimes employed, instead of Persians or Caryatides, to support the entablatures of monuments, chimney-pieces, and such like compositions. These figures owe their origin to the stones used by the ancients to mark the limits of particular possessions. Numa Pompilius, to render these inviolable, consecrated the terminus into a deity, and instituted festivals and sacrifices to his honour. In a short time, what was formerly only large upright stones, were represented in human shape; and afterwards introduced as ornaments to temples and other buildings. The termini are now principally used as ornaments for gardens and fields.

59

Chap. V. *Of Pedestals.*

Most writers consider the *Pedestal* as a necessary part of the order, without which it is not complete. It is indeed a matter of little importance whether it be considered in that light, or as a distinct composition; we shall therefore treat of a pedestal as a distinct body, having no more connection with the order than an attic, a basement, or any other part with which it may on some occasions be associated.

A pedestal consists of three principal parts; the base, the dye, and the cornice. The dye is always nearly of the same figure; being constantly either a cube or a parallelopipedon: but the base and cornice are varied and adorned with more or fewer mouldings, according to the simplicity or richness of the composition in which the pedestal is employed. Hence pedestals are, like columns, distinguished by the names of *Tuscan*, *Doric*, *Ionic*, *Corinthian*, and *Composite*.

60 Pedestals where proper.

Some authors are averse to pedestals, and compare a column raised on a pedestal to a man mounted on stilts; imagining that they were introduced merely from necessity, and for want of columns of a sufficient length. It is indeed true, that the ancients often made use of artifices to lengthen their columns; as appears by some that are in the Baptistery of Constantine at Rome; the shafts of which, being too short for the building, were lengthened and joined to their bases by an undulated sweep, adorned with acanthus leaves. Nevertheless, there are many occasions where pedestals are evidently necessary; and some in which the order, were it not so raised, would lose much of its beautiful appearance. Thus, in the inside of churches, if the columns that support the vault were immediately placed on the ground, the seats would hide their bases and a good part of their shafts; and in the theatres of the ancients, if the columns of the scene had been placed immediately on the stage, the actors would have hid a part of them from the audience. In anterior decorations, a pedestal diminishes the parts of the order, which otherwise might perhaps appear too clumsy, and hath the advantage of placing the column in a more favourable view, by raising its base near the level of the spectator's eye. In a second order of arcades, there is no avoiding pedestals; as without them it is impossible to give the arches any tolerable proportion.

61 Their proportions.

With regard to the proportion that pedestals ought to bear to that of the columns they support, it is by no means fixed. Both the ancients and moderns vary greatly on this head. Vignola's proportions are generally reckoned the best. He makes his pedestals in all the orders of the same height, *viz.* one-third of the column; and as their breadth of course increases or diminishes in the same degree as the diameters of their respective columns do, the character of the order is always preserved, which, according to any other method, is impossible.

As to the divisions of the pedestals; if the whole height be divided into nine parts, one of them may be given to the height of the cornice, two to the base, and the six remaining to the dye. The breadth of the dye is always made equal to that of the plinth of the column. The projection of the cornice may be made equal to its height; and the base being divided into three parts, two of them will be for the height of the plinth, and one for the mouldings, whose projection must be less than that of the cornice. These measures

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62 Chap. VI. *Of Intercolumniations.*

Columns are either engaged, or infulated; and, when infulated, are either very near the wall, or at a confiderable diftance from it. Engaged columns, or fuch as are near the walls of a building, are not limited in their intercolumniations, as thefe depend on the breadths of the arches, windows, niches, or other decorations placed between the columns. But columns that are entirely detached, and perform alone the office of fupporting the entablature, as in periftyles, porches and galleries, muft be near each other for the fake both of real and apparent folidity.

63 Different intercolumniations ufed by the ancients.

The intercolumniations among the ancients were various. Thofe ufed in the Ionic and Corinthian orders were the pycnoftyle, of which the interval was equal to one diameter and a half of the column; the fyftyle, whofe interval was equal to two diameters; the euftyle, to two and a quarter; the diaftyle to three, and the aræoftyle to four. In the Doric order, they ufed other intercolumniations, regulating them by the triglyphs, one of which was always placed directly over the middle of each column; fo that they were either fyftyle, monotryglyph, of one diameter and a half; diaftyle, of two diameters and three quarters; or aræoftyle, of four diameters; and the Tufcan intervals were very wide, fome of them being above feven diameters, which was very practicable, as the architraves were of wood.

Among thefe different intercolumniations, the pycnoftyle and fyftyle are too narrow; for although the ancients made frequent ufe of them, that ought rather to be afcribed to neceffity than choice. For, as the architraves were compofed of fingle ftones, extending from the middle of one column to the middle of another, it would have been difficult, efpecially in large buildings, to find blocks of a fufficient length for diaftyle intervals. With regard to the aræoftyle and Tufcan intercolumniations, they are by much too wide, and can only be ufed in ruftic buildings, where the architraves are of wood: neither is the diaftyle fufficiently folid in large compofitions. The euftyle is a medium between the narrow and broad intervals; and being at the fame time both fpacious and folid, hath been preferred to any of the reft by the ancients as well as the moderns.

64 Ufed by Vignola.

Vignola obferved nearly the fame proportion in all his intercolumniations; which practice, though condemned by feveral writers, is certainly preferable to any other; as it preferves the character of each order, and maintains in all of them an equal degree of real folidity. Setting afide therefore the pycnoftyle and fyftyle difpofitions on account of their want of fpace, and the aræoftyle for its deficiency in point of ftrength, it may be eftablifhed, that the diaftyle and euftyle intercolumniations (the latter of which, on moft occafions, ought to have the preference) may be employed in all the orders without diftinction, excepting the Doric; in which the moft perfect interval is ditriglyph; neither the monotriglyph, nor the aræoftyle, being to be fuffered but in cafes of neceffity.

Sometimes, on account of the windows, doors, niches, and other decorations, which correfpond with the intercolumniations of the periftyle, or gallery, it is not poffible to make the intervals fo narrow as euftyle, or even as diaftyle: wherefore the moderns, authorifed by fome few examples of the ancients, where grouped columns are employed, have invented a manner of difpofing them, called by Perrault *aræoftyle*, which admits of a larger interval, without any detriment to the apparent folidity of the building. This kind of difpofition is compofed of two fyftyle intercolumniations; the column that feparates them being approached towards one of thofe at the extremities, fufficient room only being left between them for the projection of the capitals; fo that the great fpace is three diameters and a half wide, and the little one half a diameter.

In periftyles, galleries, or porticoes, all the intercolumniations muft be equal; but in a logio, or porch, the middle interval may be broader than the others, by a triglyph or modilion, or three or four dentils; unlefs the columns at the angles be coupled, or grouped with pilafters; in which cafe, all the intervals fhould be of the fame dimenfions.

When buildings are very fmall, as is frequently the cafe in temples and other inventions ufed for ornamenting gardens, the intercolumniations may be broader, in proportion to the diameter of the columns, than ufual; becaufe, when they are nearer each other than three feet, there is hardly room for a bulky perfon to pafs between them.

Chap. VII. *Of Arches.*

65 Arches where proper.

Arches are not fo magnificent as colonnades; but they are more folid and lefs expenfive. They are proper for triumphal entrances, gates of cities, of palaces, of gardens, and of parks, and in general for all openings that require an extraordinary breadth.

66 How adorned.

There are various manners of adorning arches. Sometimes their piers are rufticated; fometimes they are adorned with pilafters, termini, or caryatides; and fometimes they are made fufficiently broad to admit nitches or windows. The circular part of the arch is either furrounded with ruftic key-ftones, or with an archivolt enriched with mouldings; which, in the middle, is fometimes interrupted by a confole, a mafk, ferving at the fame time as a key to the arch, and as a fupport to the architrave of the order. The archivolt is fometimes fupported by an impoft, at the head of the pier; and at others by columns placed on each fide of it, with a regular entablature, or architrave and cornice. There are likewife inftances of arcades without piers, the arches being turned on fingle columns, as in the temple of Faunus at Rome, &c. This practice, however, ought to be feldom imitated, as it is neither folid nor handfome.

When arches are large, the key-ftone fhould never be omitted, but cut in the form of a confole, and carried clofe under the foffit of the architrave, which, on account of its extraordinary length, requires a fupport in the middle. The impofts of arches fhould never be omitted; at leaft, if they be, a platform ought to fupply their place. If columns are employed without pedeftals in arcades, they fhould always be raifed on a plinth. In all arches, the circular part ought not to fpring immediately from the impoft, but

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take its rise at such a distance above it as is necessary in order to have the whole curve seen at the proper point of view.

67 Proportions.

The void or aperture of arches should never be higher nor much lower, than double their breadth; the breadth of the pier should seldom exceed two-thirds, nor be less than one-third, of the breadth of the arch; and the angular pier ought to be broader than the other, by one-half, one-third, or one-fourth; the impost should not be more than one-seventh, nor less than one-ninth of the aperture; and the archivolt must not be more than one-eighth, nor less than one-tenth of it. The breadth of the console must, at the bottom, be equal to that of the archivolt; and its sides must be drawn from the centre of the arch: the length of it must not be less than one and a half of its smallest breadth, nor more than double. The thickness of the pier depends on the breadth of the portico; for it must be strong enough to resist the pressure of its vault. But with regard to the beauty of the building, it should not be less than one-quarter of the breadth of the arch, nor more than one-third. These are the general dimensions of arches.

68

Chap. VIII. *Of Orders above Orders.*

When, in a building, two or more orders are employed, one above another, the laws of solidity require the strongest should be placed lowermost.—Hence the Tuscan must support the Doric, the Doric the Ionic, the Ionic the Composite or Corinthian, and the Composite the Corinthian.

This rule, however, is not always strictly adhered to. Most authors place the Composite above the Corinthian. There are likewise examples where the same order is repeated, as in the theatre of Statilus Taurus, and the Coliseum; and others, where an intermediate order is omitted, and the Ionic placed on the Tuscan, or the Corinthian on the Doric. But none of these practices ought to be imitated.

In placing columns above one another, the axis of all the columns ought to correspond, or be in the same perpendicular line, at least in front.

69 Proportions of columns placed above each other.

With regard to the proportions of columns placed above each other, Scamozzi's rule, That the lower diameter of the superior column should constantly be equal to the upper diameter of the inferior one, is universally esteemed the best, and gives all the columns the appearance of one long tapering tree, cut into several pieces. According to this rule, the Doric column will be to the Tuscan as $13\frac{1}{3}$ to 14; the Ionic to the Doric, as 15 to 16; the Composite or Corinthian to the Ionic, as $16\frac{2}{3}$ to 18; and the Corinthian to the Composite, as $16\frac{2}{3}$ to 20.

In Britain there are few examples of more than two stories of columns in the same aspect; and though in Italy, and other parts of Europe, we frequently meet with three, and sometimes more; yet it is a practice by no means to be imitated; for there is no possibility of avoiding many striking inconsistencies, or of preserving the character of each order in its intercolumnial decorations.

70

Chap. IX. *Of Basements.*

Instead of employing several orders one above the other in a composition, the ground-floor is sometimes made in the form of a *basement*, on which the order that decorates the principal story is placed. The proportion of these basements is not fixed, but depends on the nature of the rooms on the ground-floor. In the palace of the Porti in Vicenza, the height of the basement is equal to that of the order. In some buildings, its height exceeds two-thirds of that of the order; and, in others, only half the height of the order. It is not, however, advisable to make the basement higher than the order it supports; neither should it be lower than one half of the order.

71 Decorations, &c. of basements.

The usual method of decorating basements is with rustics of different kinds. The best, where neatness and finishing is aimed at, are such as have a smooth surface. Their height, including the joint, should never be less, nor much more, than half a module of the order placed on the basement. Their figure may be from a square to a sesquialtera; and their joints may be either squared or chamfered. The square ones should not be broader than one-eighth of the height of the rustic, nor narrower than one-tenth; and their depth must be equal to their breadth; those that are chamfered must form a rectangle; and the breadth of the whole joint may be from one-fourth to one-third of the height of the flat surface of the rustic.

Chap. X. *Of Pediments.* 72

Pediments, among the Romans, were used only as coverings to their sacred buildings, till Cæsar obtained leave to cover his house with a pointed roof, after the manner of temples. In the remains of antiquity we meet with two kinds of pediments, the triangular and the circular. The former of these are promiscuously applied to cover small or large bodies: But the latter, being of a heavier figure, are never used but as coverings to doors, niches, windows, or gates.

As a pediment represents the roof, it should never be employed but as a finishing to the whole composition.

The ancients introduced but few pediments into their buildings, usually contenting themselves with a single one to adorn the middle or principal part. But some of the moderns, and particularly the Italians, have been so immoderately fond of them, that their buildings frequently consist of almost nothing else.

The girder being a necessary part in the construction of a roof, it is an impropriety to intermit the horizontal entablature of a pediment, by which it is represented to make room for a niche, an arch, or a window.

73 Forms, &c. of pediments.

In regular architecture, no other form of pediments can be admitted, besides the triangular and circular. Both of them are beautiful; and when a considerable number of pediments are introduced, as when a range of windows are adorned with them, these two figures may be used alternately, as in the niches of the Pantheon, and in those of the temple of Diana at Nismes.

The proportion of pediments depend upon their size; for the same proportions will not do in all cases.

When the base of the pediment is short, its height must be increased; and when the pediment is long, the height must be diminished. The best proportion for

Principles. for the height is from one-fifth to one-fourth of the base, according to the extent of the pediment, and the character of the body it covers. The materials of the roof must also be attended to; for if it be covered with tiles, it will be necessary to raise it more than one-quarter of the base, as was the custom of the ancients in their Tuscan temples.

The tympan is always on a line with the front of the frize; and when large, admits of various ornaments.

74

Chap. XI. *Of Ballustrades.*

Ballustrades are sometimes of real use in buildings; and at other times they are only ornamental. Such as are intended for use, as when they are employed in stair-cases, before windows, or to inclose terrasses, &c. must always be nearly of the same height; never exceeding three feet and a half, nor ever less than three. But those that are principally designed for ornament, as when they finish a building, should be proportioned to the architecture they accompany: and their height ought never to exceed four-fifths of the height of the entablature on which they are placed; nor should it ever be less than two-thirds thereof, without counting the zocholo, or plinth, the height of which must be sufficient to leave the whole ballustrade exposed to view.

75 Proportion, &c. of ballusters.

The best proportion for ballustrades is to divide the whole given height into thirteen equal parts; eight of these for the height of the balluster, three for the base, and two for the cornice or rail; or into fourteen, (if it be required to make the balluster less), giving eight parts to the balluster, four to the base, and two to the rail. One of these parts may be called a *module;* and being divided into nine minutes, may serve to determine the dimensions of the particular members.

In ballustrades, the distance between two ballusters should not exceed half the diameter of the balluster measured in its thickest part, nor be less than one-third of it.

The breadth of the pedestals, when they are placed on columns or pilasters, is regulated by them; the dye never being made broader than the top of the shaft, nor much narrower; and when there are neither columns nor pilasters on the front, the dye should not be much lower than a square, and seldom higher. On stairs, or on any other inclined planes, the same proportions are to be observed as on horizontal ones.

Chap. XII. *Of Gates, Doors, and Piers.*

76 Doors and Gates.

There are two kinds of entrances, *viz.* doors and gates. The former serve only for the passage of persons on foot; but the latter likewise admit horsemen and carriages. Doors are used as entrances to churches and other public buildings, to common dwelling-houses, and apartments: And gates serve for inlets to cities, fortresses, parks, gardens, palaces, &c. The apertures of gates being always wide, they are generally made in the form of an arch, that figure being the strongest. But doors, which are generally of small dimensions, are commonly parrallelograms, and closed horizontally.

The general proportion for the apertures, both of gates and doors, whether arched or square, is, that the height be about double the breadth. Principles.

77 Piers.

The most common, and indeed almost the only ornaments for gates are the piers by which they are supported, and which were originally no more than bare posts into which the hinges of the gate were driven. Though this, however, is the only proper use of piers, it must be concealed as much as possible, and they must seem as if placed there only for ornament. As they are to be fixed to the wall before the house, so they must also be proportioned to it; and as they are to be seen in the same view with the front of the house, their correspondence with it is equally necessary. They are to be placed on a plinth, and something must be allowed by way of ornament and finishing at the top. All the luxuriance of fancy may be employed in the decoration of piers: but it will be proper to observe this general rule, that the pier being an inferior building, it must never be richer than the front of the house. If, for instance, the front of the house is ornamented with columns of the Doric order, the Ionic must not be used in the piers; and it will be found better to omit columns altogether, than to make use of the Tuscan order for piers in any case. If the Ionic or Corinthian orders are employed in the front of the house, the Doric or Ionic may be used with propriety in the piers. One piece of ornament is almost universal in piers, namely, a niche with its seat, made as if for the conveniency of weary travellers. On this account, it will be proper to raise the columns on pedestals, because the continued moulding from their cap will be a good ornament under the niche. The base of the columns ought always to be the Attic.

Inside-doors, however small the building may be, should never be narrower than two feet nine inches; nor should they ever, in private houses, exceed three feet six inches in breadth, which is more than sufficient to admit the bulkiest person. Their height should at least be six feet three or four inches; otherwise a tall person cannot pass without stooping. In churches, palaces, &c. where there is a constant ingress and egress of people, the apertures must be larger. The smallest breadth that can be given to a gate is $8\frac{1}{2}$ or 9 feet, which is but just sufficient for the passage of a coach.

Plate XLIV. fig. 1. Is a rustic door, composed by the celebrated Vignola, in which the aperture occupies two-thirds of the whole height, and one-half of the whole breadth; the figure of it being a double square. The rustics may be either smooth or hatched; their joints must form a rectangle, and the breadth of each joint may be one-third, or two-sevenths, of the vertical surface of a rustic. The joints of the claveaux, or key-stones, must be drawn to the summit of an equilateral triangle, whose base is the top of the aperture. The architrave surrounding the aperture may be composed either of a large ogee and fillet, or of a platband and fillet. Its whole breadth must be one-tenth of the breadth of the aperture; the remaining part of each pier being for the rustics. The entablature is Tuscan: the cornice is to be one-fifteenth of the whole height of the door; and what remains below it being divided into 21 equal parts, the two uppermost of them will be for the frize and architrave, and the remaining 19 for the rustics and plinth at the foot of the door.

Fig. 2. Is a disposition of Michael Angelo's. The windows of the Capitol at Rome are of this kind; and Sir Christopher Wren hath executed doors of the same kind under the semicircular porches in the flanks of St Paul's. The figure of the aperture may be a double square; the architrave one-sixth of the breadth of the aperture; and the whole entablature one-quarter of its height. The front of the pilasters or columns on each side, must be on a line with the fascia of the architrave; and their breadth must be a semidiameter.

Fig. 3. Is likewise a design of Vignola's. It is of the Corinthian order, and executed in the Cancellaria at Rome. The height is equal to double its breadth; and the whole ornament at the top is equal to one-third of the height of the aperture. The architrave is in breadth one-fifth of the breadth of the aperture; and the pilasters that support the consoles are half as broad as the architrave. The whole is well imagined, but rather heavy; and it will be best to reduce the architrave to one-sixth of the aperture, diminishing the entablature proportionally.

Fig. 4. Is a design of Serlio's. The aperture may be either twice as high as broad, or a trifle less. The diameter of the columns may be equal to one-quarter of the breadth of the aperture; and their height may be from eight diameters to eight and a half. The entablature must be somewhat less than one-quarter of the height of the columns; and the height of the pediment may be one-quarter of its base.

Fig. 5. Is a door in the salon of the Farnese at Rome, designed by Vignola. The aperture forms a double square. The entablature is equal to three-elevenths of its height, the architrave being one of these elevenths; and the whole ornaments on the sides, consisting of the architrave and pilasters, is equal to two-sevenths of the breadth of the aperture: the cornice is Composite, enriched with mutules and dentils; and the frize is adorned with a festoon of laurel.

Fig. 6. Is copied from a door at Florence, said to be a design of Cigoli's. The height of the aperture is a trifle more than twice its breadth. It is arched; and the impost is equal to half a diameter. The columns are Ionic, somewhat above nine diameters high; and their shafts are garnished each with five rustic cinctures. The entablature is less than one-quarter of the column; and the breadth of the tablet, in which there is an inscription, is equal to the breadth of the aperture.

Plate XLV. fig. 1. Is a pier invented by Mr Chambers. Its diameter may be one-quarter of its height, exclusive of the plinth and vase; and the height of both these may be equal to one diameter of the pier, or a trifle less. The rustics may either be plain, hatched, or vermiculated: the height of each course may be one-eleventh part of the height of the pier, counting to the top of the entablature; the entablature two-elevenths; and the base of the pier one-eleventh part.

Fig. 2. Is likewise a composition of Mr Chambers, imitated from M. Angelo Buonaroti's design for Cardinal Sermonetti. The height of the aperture is somewhat more than twice its breadth; which breadth occupies one-third of the breadth of the whole composition. The order is Composite; and the height of the entablature is equal to one-quarter of the height of the column. He has made a break in it over each column: but, unless the column project considerably, it will be as well to carry the entablature on in a straight line. The dimensions of the particular parts may be measured on the design.

Fig. 3. Is also a composition of Mr Chambers, executed at Goodwood, the seat of his grace the duke of Richmond, in Sussex. The diameter is one-quarter of the height, exclusive of the finishing, which is equal to one diameter: and the height of the pier, from the top of the entablature downwards, being divided into eleven and a half parts, one of these parts is given to the base, one to each rustic, and one and a half to the astragal, frize, and cornice.

Fig. 4. Is a composition of the late earl of Burlington's, that great architect and patron of the fine arts, which is executed at Chiswick, and at Bedford-house in Bloomsbury-square with some little difference.

Fig. 5. Is an invention of Mr Chambers.

Fig. 6. Is one of Inigo Jones's; of which kind he hath executed a couple at Aimsbury in Wiltshire, the seat of his grace the duke of Queensberry.

Chap. XIII. *Of Windows.*

78 Proportions of windows.

The first considerations with regard to windows is their size, which varies according to the climate, the destination of the building, &c. In Britain, the windows of the smallest private houses are commonly from 3 to $3\frac{1}{2}$ feet broad; and being generally twice their breadth in height, or somewhat more, in the principal apartments, they generally rise to within a foot or two of the ceilings of the rooms, which are frequently no higher than 10 feet, and at most 12 or 13. But, in more considerable houses, the apartments are from 15 to 20 feet high, and sometimes more; and in these the windows are from 4 to 5 and $5\frac{1}{2}$ feet broad, and high in proportion. These dimensions are sufficient for dwelling-houses of any size in that country; when they are larger, they admit too much of the cold air in winter. But churches, and other buildings of that kind, may have larger windows, proportioned to the size of the structures.

The proportions of the apertures of windows depend upon their situation. Their breadth in all the stories must be the same; but the different heights of the apartments make it necessary to vary the height of the windows likewise. In the principal floor, it may be from $2\frac{1}{8}$ of the breadth to $2\frac{1}{3}$, according as the rooms have more or less elevation. In the ground-story, where the apartments are lower, the apertures of the windows seldom exceed a double square; and, when they are in a rustic basement, they are frequently made much lower. The height of the windows of the second floor may be from $1\frac{1}{2}$ of their breadth to $1\frac{4}{5}$; and Attics and Mezzanines may be either a perfect square, or somewhat lower.

79 How ornamented.

The windows of the principal floor are generally most enriched. The simplest method of adorning them is, with an architrave surrounding the aperture, and

ARCHITECTURE

Plate XLIV

Fig 1

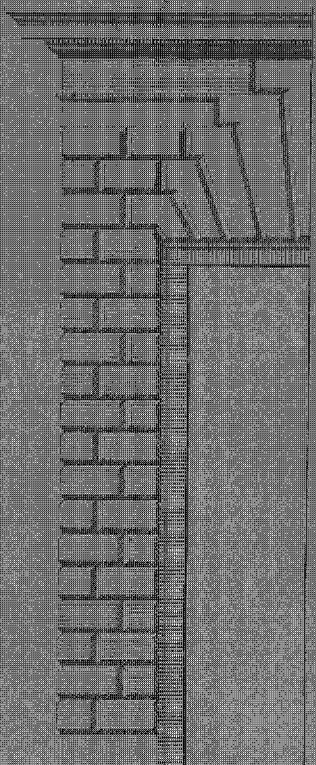


Fig 2

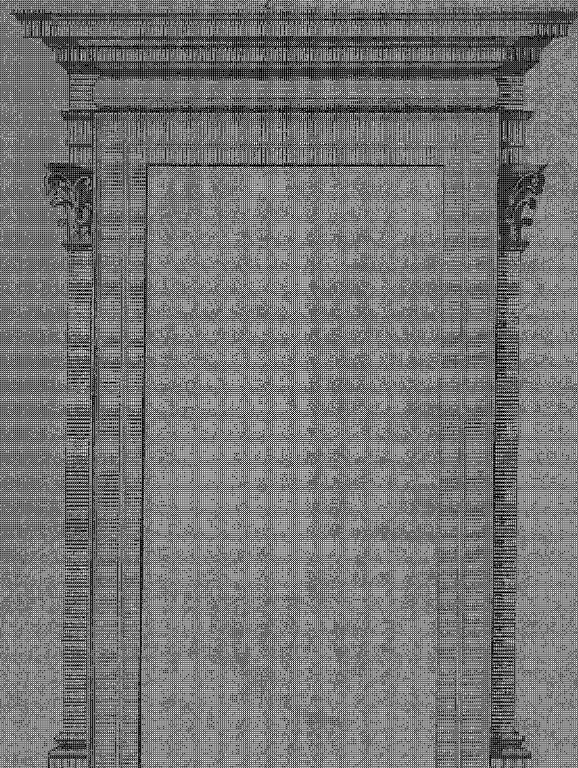


Fig 3

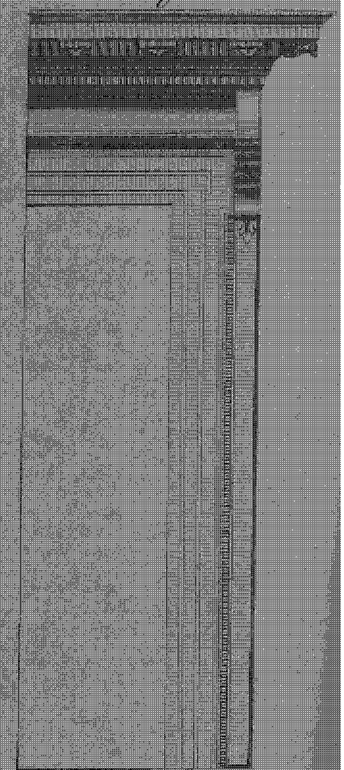


Fig 4

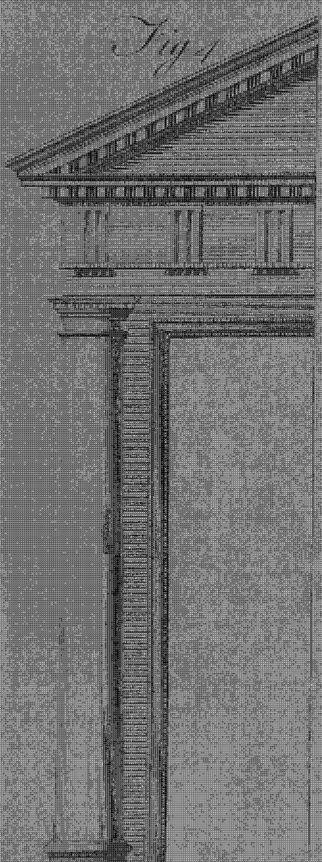


Fig 5

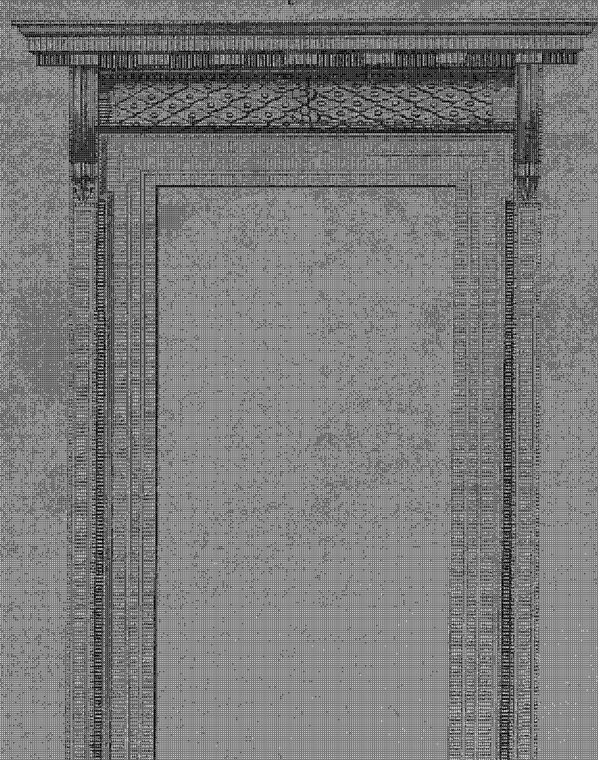
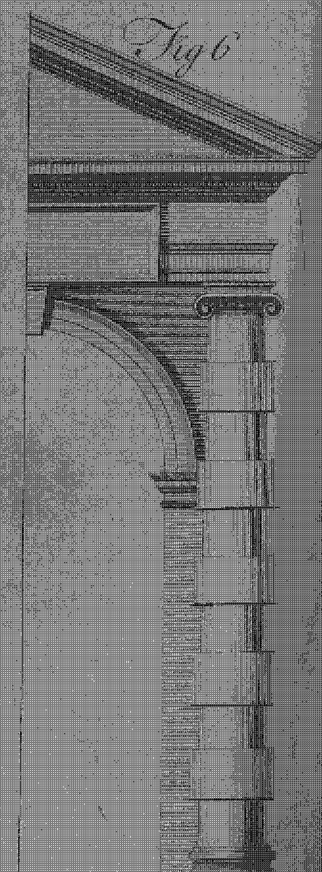
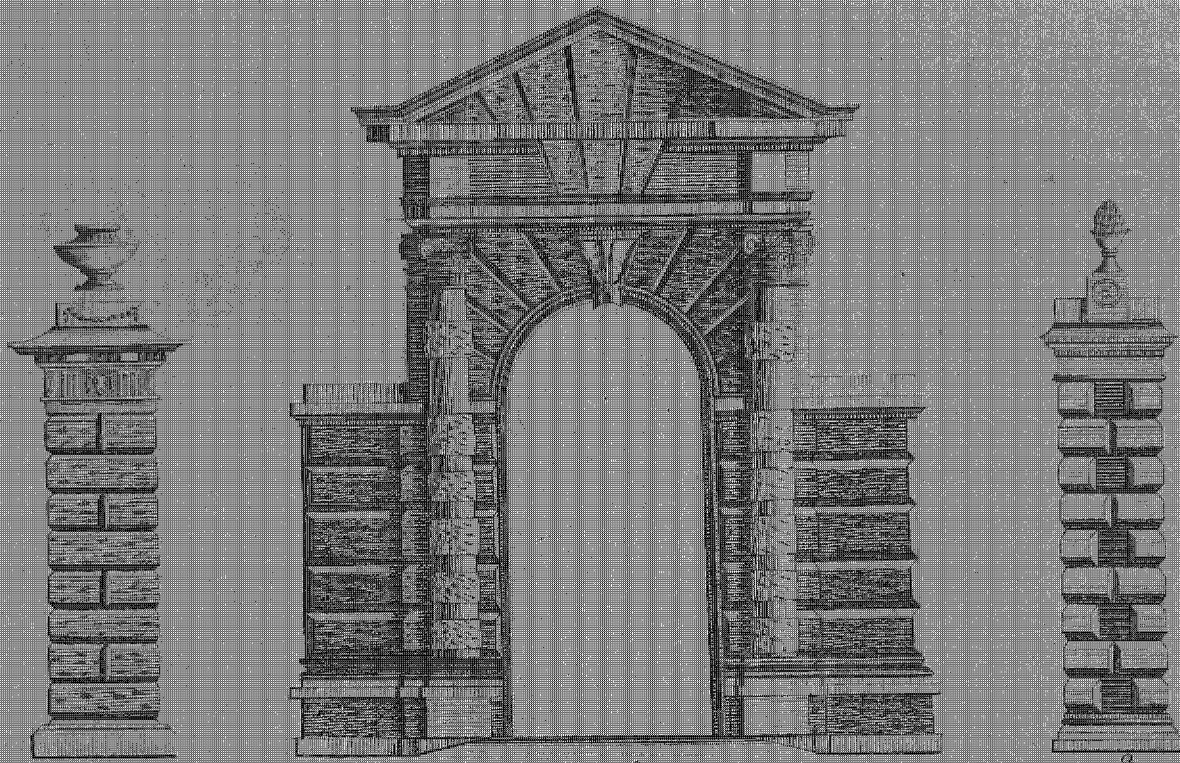


Fig 6



R. Scot Sculp. Phil.



1 2 3

Designs for Gates & Piers

4 5 6

Scot Philada

Fig. 1

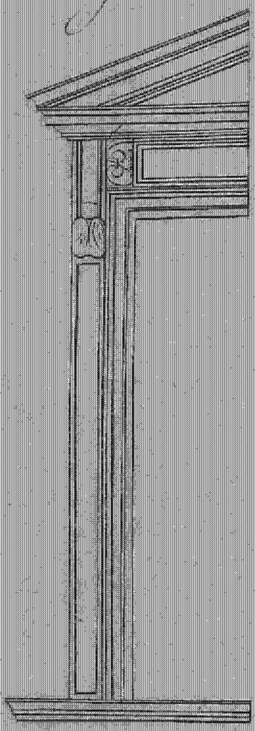


Fig. 2

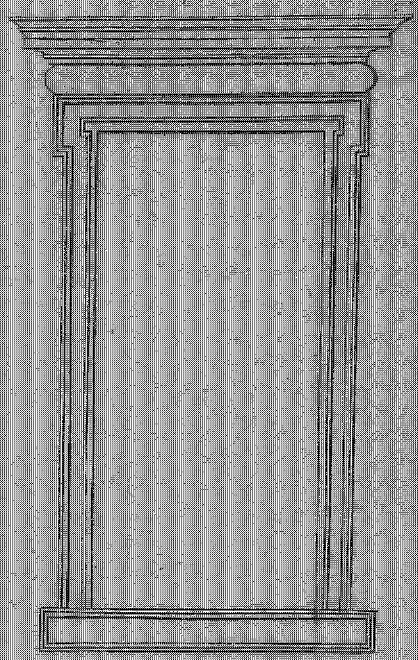


Fig. 3

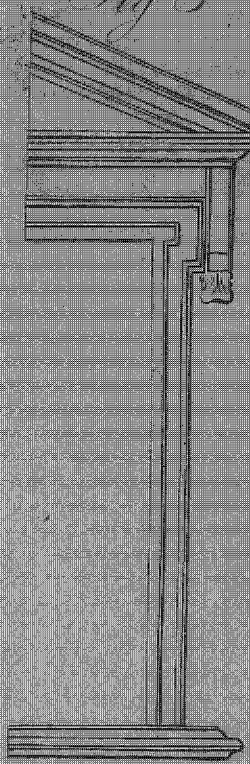


Fig. 4

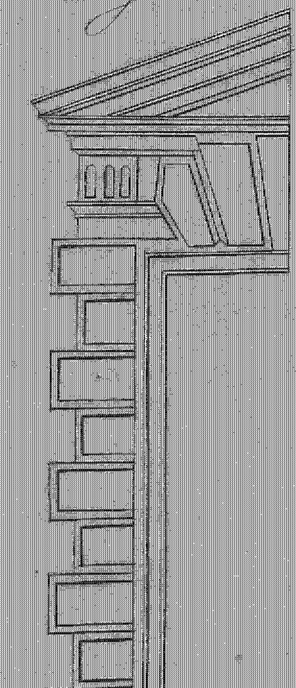


Fig. 5

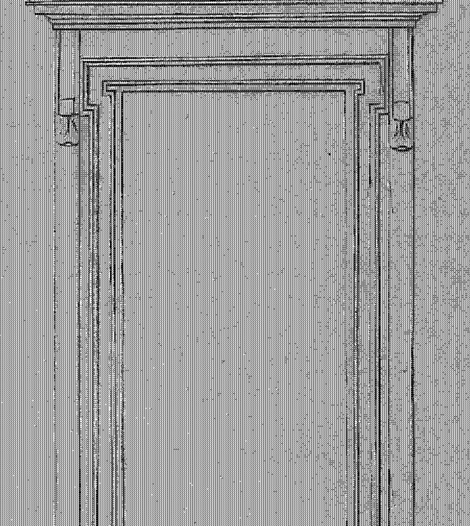
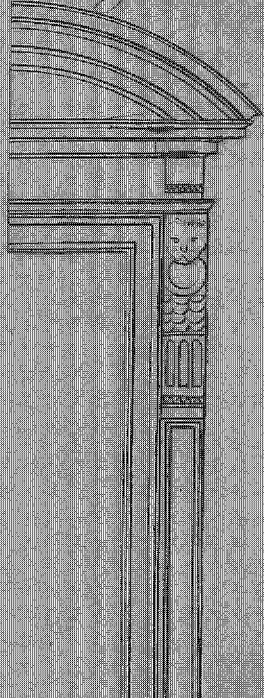


Fig. 6



Sect. Philad.a

and crowned with a frize and cornice. The windows of the ground-floor are ſometimes left entirely plain, without any ornament; and at others they are ſurrounded with ruſtics, or a regular architrave with a frize and cornice. Thoſe of the ſecond floor have generally an architrave carried entirely round the aperture; and the ſame is the method of adorning Attic and Mezzanine windows: but the two laſt have ſeldom either frize or cornice; whereas the ſecond-floor windows are often crowned with both.

The breaſts of all the windows on the ſame floor ſhould be on the ſame level, and raiſed above the floor from two feet nine inches to three feet ſix inches at the very moſt. When the walls are thick, the breaſts ſhould be reduced under the apertures, for the conveniency of looking out. In France, the windows are frequently carried quite down to the floor. When the building is ſurrounded with gardens, or other beautiful objects, this method renders the rooms exceeding pleaſant.

The interval between the apertures of windows depends in a great meaſure on their enrichments. The breadth of the aperture is the leaſt diſtance that can be between them; and twice that breadth ſhould be the largeſt in dwelling-houſes; otherwiſe the rooms will not be ſufficiently lighted. The windows in all the ſtories of the ſame aſpect muſt be placed exactly above one another.

Plate XLVI. fig. 1. Is a deſign of P. Leſcot, abbot of Clagny, executed in the old Louvre at Paris. The apertures may be a double ſquare, or a trifle more; the architrave from one-ſixth to one-ſeventh of the breadth of the aperture: the pilaſter is equal to that beadth, when the architrave is narrow; or leſs, by one-quarter, or one-fifth, when it is broad. The whole entablature ſhould not exceed one-quarter of the height of the aperture, nor be much lower. The conſoles may be equal in length to half the breadth of the aperture at moſt, and to one-third of it at leaſt.

Fig. 2. Is a deſign of Palladio's, executed at the Chiericato in Vicenza: its proportions are not much different from the following. The plat-band that ſupports the window is equal to the breadth of the architrave.

Fig. 3. Is likewiſe a deſign of Palladio's, executed by him in many of his buildings. The aperture is a double ſquare. The breadth of the architrave is one-ſixth of the breadth of the aperture; and the frize and cornice together are double the height of the architrave. The breadth of the conſoles is two-thirds of the breadth of the architrave.

Fig. 4. Is a deſign of Ludovico da Cigoli; and executed in the ground-floor of the Ranunchini palace at Florence.

Fig. 5. Is a deſign of Inigo Jones, executed at the Banqueting-houſe. The aperture may be a double ſquare; the architrave may be one-ſixth of its breadth; the whole entablature one-quarter of its height; and the breadth of the conſoles two thirds of the breadth of the architrave.

Fig. 6. Is a deſign of M. Angelo Buonorati, executed at the Farneſe.

80 CHAP. XIV. *Of Niches and Statues.*

It hath been cuſtomary, in all ages, to enrich different parts of buildings with repreſentations of the human body. Thus the ancients adorned their temples, baths, theatres, &c. with ſtatues of their deities, heroes, and legiſlators. The moderns ſtill preſerve the ſame cuſtom, placing in their churches, palaces, &c. ſtatues of illuſtrious perſons, and even groups compoſed of various figures, repreſenting occurrences collected from hiſtory, fables, &c. Sometimes theſe ſtatues or groups are detached, raiſed on pedeſtals, and placed contiguous to the walls of a building, or in the middle of a room, court, or public ſquare. But they are moſt frequently placed in cavities made in the walls, called 81 *niches*. Of theſe there are two ſorts; the one formed like an arch in its elevation, and ſemicircular or ſemi-elliptical in its plan; the other is a parallelogram both in its plan and elevation.

Different kinds of niches.

The proportion of both theſe niches depends on the characters of the ſtatues, or the general form of the groups placed in them. The loweſt are at leaſt a double ſquare in height; and the higheſt never exceed $2\frac{1}{4}$ of their breadth. 82

How decorated.

With regard to the manner of decorating them, when they are alone in a compoſition, they are generally incloſed in a pannel, formed and proportioned like the aperture of a window, and adorned in the ſame manner. In this caſe, the niche is carried quite down to the bottom; but on the ſides and at the top, a ſmall ſpace is left between the niche and the architrave of the pannel. And when niches are intermixed with windows, they may be adorned in the ſame manner with the windows, provided the ornaments be of the ſame figure and dimenſions with thoſe of the windows. 83

Statues.

The ſize of the ſtatues depends on the dimenſions of the niches. They ſhould neither be ſo large as to have the appearance of being rammed into the niches, as in Santa Maria Majora at Rome; nor ſo narrow as to ſeem loſt in them, as in the Pantheon. The diſtance between the outline of the ſtatue and ſide of the niche ſhould never be leſs than one-third of a head nor more than one half, whether the niche be ſquare or arched; and when it is ſquare, the diſtance from the top of the head to the cieling of the niche ſhould not be greater than the diſtance on the ſides. Statutes are generally raiſed on a plinth, the height of which may be from one-third to one-half of a head; and ſometimes, where the niches are large, the ſtatues may be raiſed on ſmall pedeſtals.

The character of the ſtatue ſhould always correſpond with the character of the architecture with which it is ſurrounded. Thus, if the order be Doric, Hercules, Jupiter, Mars, Æſculapius, and all male ſtatues, repreſenting beings of a robuſt and grave nature, may be introduced; if Ionic, then Apollo, Bacchus, &c.; and if Corinthian, Venus, Flora, and others of a delicate nature, ſhould be employed.

CHAP. XV. *Of Chimney-pieces.*

AMONG the ancients, there are very few examples of chimney-pieces to be met with. Neither the Italians nor French have excelled in compoſitions of this kind. Britain, by being poſſeſſed of many able ſculptors at different times, has ſurpaſſed all other nations, both in taſte of deſign, and workmanſhip.

 The

Principles. 85 Proportions and [illegible] The size of the chimney must be regulated by the dimensions of the room where it is placed. In the smallest apartments, the breadth of the aperture should never be less than three feet, or three feet six inches. In rooms from 20 to 24 feet square, or of equal superficial dimensions, it may be from four to $4\frac{1}{2}$ feet broad; in those of 24 to 27, from $4\frac{1}{2}$ to 5; and, in such as exceed these dimensions, the aperture may even be extended to $5\frac{1}{2}$ or 6 feet.

The chimney should always be situated so as to be immediately seen by those who enter the room. The middle of the partition wall is the most proper place in halls, salons, and other rooms of passage; but in drawing-rooms, dressing-rooms, and the like, the middle of the back-wall is the best situation. In bed-rooms, the chimney is always in the middle of one of the partition-walls; and in closets, and other very small places, to save room, it is put in a corner. Wherever two chimneys are used in the same room, they should be placed either directly facing each other, if in different walls, or at equal distances from the centre of the wall in which they both are.

The proportion of the apertures of chimney-pieces of a moderate size is generally a perfect square; in small ones, it is a trifle higher; and in large ones, a trifle lower. Their ornaments consist in architraves, frizes, cornices, columns, pilasters, termini, caryatides, consoles, and all kinds of ornaments of sculpture, representing animals and vegetables, &c. likewise vases, chalices, trophies of arms, &c. In designing them, regard must be had to the nature of the place where they are to be employed. Such as are intended for halls, salons, guard-rooms, galleries, and other large places, must be composed of large parts, few in number, of distinct and simple forms, and having a bold relief; but chimney-pieces for drawing-rooms, dressing-rooms, &c. may be of a more delicate and complicated nature.

Chimney-pieces are composed of wood, stone, or marble; the last of which ought to be preferred, as figures or profiles are best represented in a pure white.

Plate XLVII. exhibits different designs for chimney-pieces by Palladio and Inigo Jones. Their proportion may be gathered from the designs, which are accurately executed.

86

Chap. XVI. *Of the Proportions of Rooms.*

The proportions of rooms depend in a great measure on their use, and actual dimensions: but, with regard to beauty, all figures, from a square to a sesquilateral, may be employed for the plan.

The height of rooms depends on their figure. Flat cieled ones may be lower than those that are coved. If their plan be a square, their height should not exceed five-sixths of the side, nor be less than four-fifths; and when it is oblong, their height may be equal to their breadth. But coved rooms, if square, must be as high as broad; and when oblong, they may have their height equal to their breadth, more one-fifth, one-quarter, or even one-third of the difference between the length and breadth: and galleries should at least be in height one and one-third of their breadth, and at most one and a half, or one and three-fifths.

The coldness of the British climate is a strong objection to high rooms; so that it is not uncommon to see the most magnificent apartments not above 15, 16, or at most 18 feet high; though the extent of the rooms would require a much more considerable elevation. But where beauty is aimed at, this practice ought not to be imitated. Principles. 87 High rooms improper in Britain.

When rooms are adorned with an entire order, the entablature should never exceed one-sixth of the whole height in flat-cieled rooms, and one-sixth of the upright part in coved ones; and when there are neither columns nor pilasters, but only an entablature, its height should not be above one-seventh of these heights. If the rooms be finished with a simple cornice, it should never exceed one-fourteenth, nor ever be less than one-fifteenth part of the above-mentioned height.

Chap. XVII. *Of Cielings.* 88

Cielings are either flat or coved, in different manners. The simplest of the flat kind are those adorned with large compartments, surrounded with one or several mouldings, either let into the cieling, or projecting beyond its surface: and when the mouldings that form the compartments are enriched, and some of the compartments adorned with well-executed ornaments, such cielings have a good effect, and are very proper for common dwelling-houses, and all low apartments. Their ornaments and mouldings do not require a bold relief; but, being near the eye, they must be finished with taste and neatness. For higher rooms, a flat cieling which has the appearance of being composed of various joists framed into each other, and forming compartments of various geometrical figures, should be employed. The sides of the joists forming the compartments are generally adorned with mouldings, and represent either a simple architrave, or an architrave cornice, according to the size of the compartments and the height of the room.

Coved cielings are more expensive; but they are likewise more beautiful. They are used promiscuously in large and small rooms, and occupy from one-fifth to one-third of the height of the room. If the room be low in proportion to its breadth, the cove must likewise be low; and when it is high, the cove must be so likewise: by which means the excess of the height will be rendered less perceptable. But, where the architect is at liberty to proportion the height of the room to its superficial dimensions, the most eligible proportion for the cove is one-fourth of the whole height. In parallelogram-figured rooms, the middle of the cieling is generally formed into a large flat pannel. This pannel, with the border that surrounds it, may occupy from one-half to three-fifths of the breadth of the room. The figure of the cove is commonly either a quadrant of a circle or of an ellipse, taking its rise a little above the cornice, and finishing at the border round the great pannel in the centre. The border projects somewhat beyond the coves on the outside; and, on the side towards the pannel, it is generally made of sufficient depth to admit the ornaments of an architrave, or architrave and cornice.

In Britain circular rooms are not much in use; but they

Principles. they are very beautiful. Their height must be the same with that of square rooms; their ceilings may be flat; but they are handsomer when coved, or of a concave form.

Arcs doublaux, or soffits of arches, when narrow, are ornamented with *guillochs*, or frets; but when broad, they may be adorned in a different manner.

When the profiles of the room are gilt, the ceilings ought likewise to be gilt. The usual method is to gild all the ornaments, and to leave the grounds white, pearl colour, light blue, or of any other tint proper to set off the gilding to advantage. Painted ceilings, so common in France and Italy, are but little used in Britain.

89 CHAP. XVIII. *Of Stairs and Stair-cases.*

THERE are many kinds of stair-cases; for, in some, the steps are made strait; in others, winding; in others, mixed of both. Of straight stairs, some fly directly forward, others are square, others triangular. Others are called *French flights*, or *winding-stairs*, (which in general are called *spiral*, or *cockle-stairs*); of which some are square, some circular or round, and some elliptical or oval; and these again are various, some winding about a solid, others about an open newel. Stairs mixed of straight and winding steps are also of various kinds; some are called *dog-legged*; some there are that wind about a solid newel, and others that fly about a square open newel.

90 Stair-cases where to be placed. Great care ought to be taken in placing of the stair-case in any building; and therefore stair-cases ought to be described and accounted for justly when the plan of a building is made. For want of this, sometimes unpardonable errors have been committed: such as having a little blind stair-case to a large house, or, on the other hand, a large spacious stair case to a little one.

Palladio says, in placing stair-cases, the utmost care ought to be taken; it being difficult to find a place convenient for them, that will not at the same time prejudice the rest of the building. But commonly the stairs are placed in the angle, wing or middle of the front.

To every stair-case are required three openings.

First, the door leading thereto.

Secondly, the window, or windows that give light to it;

And, thirdly, the landing.

First, the door leading to the stair-case should be so placed, that most of the building may be seen before you come at the stairs, and in such a manner that it may be easy for any person to find out.

Secondly, for the windows; if there be but one, it must be placed in the middle of the stair-case, that thereby the whole may be enlightened.

Thirdly, the landing of stairs should be large and spacious for the convenient entering into rooms: in a word, stair-cases should be spacious, light, and easy in ascent. The height of large steps must never be less than six inches, nor more than seven inches and a half.

The breadth of steps should never be less than 10 inches, or more than 18 inches; and the length of them not less than three feet, nor more than 12.

Plate XLVIII. fig. 1. A stair-case of two flights.—*A* shews the manner of drawing the *ramp*, which is to rise equal to the height of the first step of the next flight, and as much as its *kneeling*; as is shewn by the *ramp* intersecting the rail of the second flight. Principles. 91

Fig. 2. Shews the straight rail intersecting a circular cap.

Fig. 3. Section of two different hand rails.

Fig. 4. Shews the manner of dove-tailing the riser into the step.

Plate XLIX. fig. 1. represents a stair-case, with flights, and its landing rail. 92

Fig. 2. Shews the solid part of the step out of which the scroll is formed: where *a* represents the *oversail* of the step; *b*, The thickness of the bracket, with its *mitring* to the *riser*; and, *c*, The *string-board*.

Fig. 4. Shews the scale for drawing the scroll of fig. 3.—To perform which, take the distance from 1 to the centre, in fig. 3. and set it up from 1 to the centre in fig. 4.; divide that extent into three parts, then set 4 such parts on the upper side of the scale, and draw the line from 4 to one; set one foot of your compasses at 4, and strike the circular line; let that be divided into 12 equal parts, and then draw lines from 4 through those divisions to the upright line.

The scale being thus made, draw the scroll of fig. 3. by it in the following manner.

Set one foot of your compasses in 1, and describe a stroke at *c*; take the same distance, and with one foot in 2, cross the stroke at *c*; then from *c*, turn the part from 1 to 2, and proceed in the same manner; for if the distance were taken in the scale from 1 to the centre, it would strike the circle too flat; and if taken from 2, it would strike the circle too quick.

When this is well understood, there will be little difficulty in drawing the scroll below figure 2.; which throws itself out farther in proportion than that in fig. 3.; for this will always be the case when the upper line of the scale, which consists of four divisions in fig. 4. is made but with three divisions or less; whence it appears, that the upper line of the scale may be drawn at what length you please, according as you would bring in or keep out the scroll.

Plate L. Shews the manner of squaring twist-rails. 93

Fig. 2. Exhibits the pitch-board, to shew what part of the step the twisted part of the rail contains; the three dotted lines drawn from the rail to the pitch-board represent the width of the rail, which is to be kept level. The dotted lines *a* and *b* shew how much half the width of the rail turns up from its first beginning to 3.

Fig. 3. Shews the same pitch-board with the manner of the rail's turning up. If the sides of the twisted part of the rail be shaped by the rail-mould, so that they direct down to its ground plan, that is, the upper side of the rail being first struck by the mould, then apply the mould to the under side, as much back as the level of the pitch-board shews, by being struck on the side of the rail, and then fig. 3. being applied to the outside of the rail, from its first twisting part to 3, will show how much wood is to be taken off.

Fig. 5.

Practice.

Fig. 5. Exhibits the square of the rail, with the raking line of the pitch-board drawn through the middle on the upper side; then draw the depth of the side of the rail parallel to this, and the dotted lines from the diagonal of the rail; these lines shew what quantity of wood will be wanting on the upper and lower sides of the rail. Set your compasses at *c*, and draw the circular stroke from the raking part of the pitch-board to *b*; take the distance *a b* and transfer it from *a* to *b*, in fig. 7. The several distances thus found may be set at any number of places, ranging with the straight part of the rail; and it then forms the width of the mould for the twisting part of the rail.

Fig. 7. Shows the sweep of the rail. The rail cannot be fixed less than one-fourth part from the *nosing* or front of the step.

The remaining part of the pitch-board may be divided into any number of parts, as here into four; from these divisions draw lines across the pitch-board to the raking line; then take the distances from the ground line of the pitch-board to the plan of the rail and set them perpendicular from the raking line of the pitch-board; and these divisions when the rail is in its proper position, lie directly over the divisions on the ground plan.

In this figure, *l*, *m*, and *n*, rise as much above *o* as the dotted line in fig. 5. does above the width of the rail; and they sink as much below *o* as the other dotted line in fig. 5. falls below the width of the rail; the same thicknesses must be glued upon *o*, though the greatest part will come off in squaring. The reason of placing the letters *l*, *m*, and *n*, where they are, is, that they might not obstruct the small divisions of the rail-mould.

Fig. 4. Shews how to find the rail when it takes more than one step. The remaining part of the pitch-board is divided into four parts, as before in fig. 7. and it takes in two such parts of the next step. Draw lines from these divisions to the diagonal of the pitch-board as in fig. 7. then take the distance *a b*, and set it from *c* to *d*, and so proceed with the other divisions.

Another way to find the outside of the rail-mould is, to draw all the divisions across the plan of the rail; then take the distance from the ground line of the pitch-board to 4, transfer it from the diagonal of the pitch-board to 4 on the rail; and so proceeed with the other distances. Now, when the rail is put in its proper situation *c* will be perpendicular to *b*, and all the divisions, as 1, 2, 3, 4, *&c.* in the rail, will be perpendicular to 1, 2, 3, 4, *&c.* in the ground plan.

Practice.

Fig. 6. Shews the plan of a rail of five steps.

To find the rail.—Set five divisions, as from *e* to *h*, which is the height of the five steps; draw the diagonal *h* to the plan of the rail; then take the distance *e f*, and transfer in to *g h*, and proceed in the same manner with the other seven distances.

To find the width of the rail mould.—Draw the lines across the plan of the rail, as at *k*; set that distance from the diagonal to *i*; and so proceed with the rest, as was shewn in fig. 4.

Having formed the sides of the rail perpendicular to its ground plan, and having squared the lower end of the rail, then take a thin lath, and bend it with the rail, as is represented by *m*, fig. 1.

This is the readiest method of squaring a solid rail; but if the rail be bent in the thicknesses, the nosing of the steps must be drawn upon a cylinder, or some other solid body of a sufficient width to contain the width of the rail or string-board.

r represents the depth of the rail, touching the nose of each step. Take a sufficient number of thicknesses of this width, to make the thickness of your rail; glue them all together upon your cylinder or templet, confine them till they are dry, and the rail taken off is ready squared. Proceed in the same manner with the architrave, marked *a*.

Chap. XIX. *Of Roofs.* 94

Plate LI. Fig. 1. Shews the form of a trussed roof, with three ring-posts, that may carry seventy feet, or upwards.

Fig. 2. Exhibits an *M* roof, capable of carrying as great an extent as the former. Indeed both these designs are capable of carrying almost any extent.

Fig. 3. Represents two different sorts of trusses.

Fig. 4. Shews the manner of piecing timber. Sometimes the joint may be extended as far as *a*, with another bolt through it. To the right is shewn a different sort of joint.

Fig. 5. Shews the manner of trussing a girder. If the trusses are full long, with the pieces *b* and *c* you may make them as light as you please.

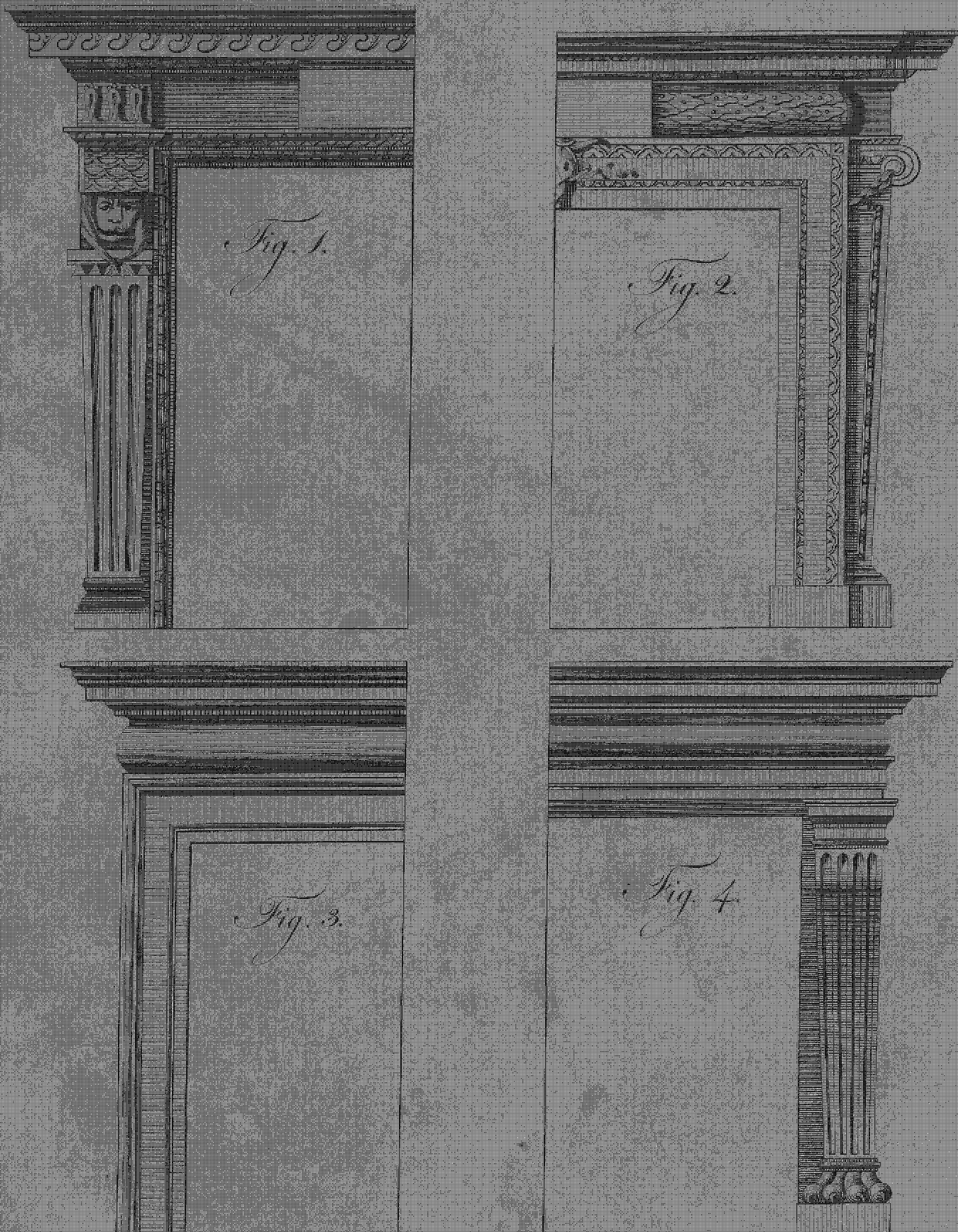
Fig. 6. Represents the manner of trussing partitions.

Part II. PRACTICE of ARCHITECTURE.

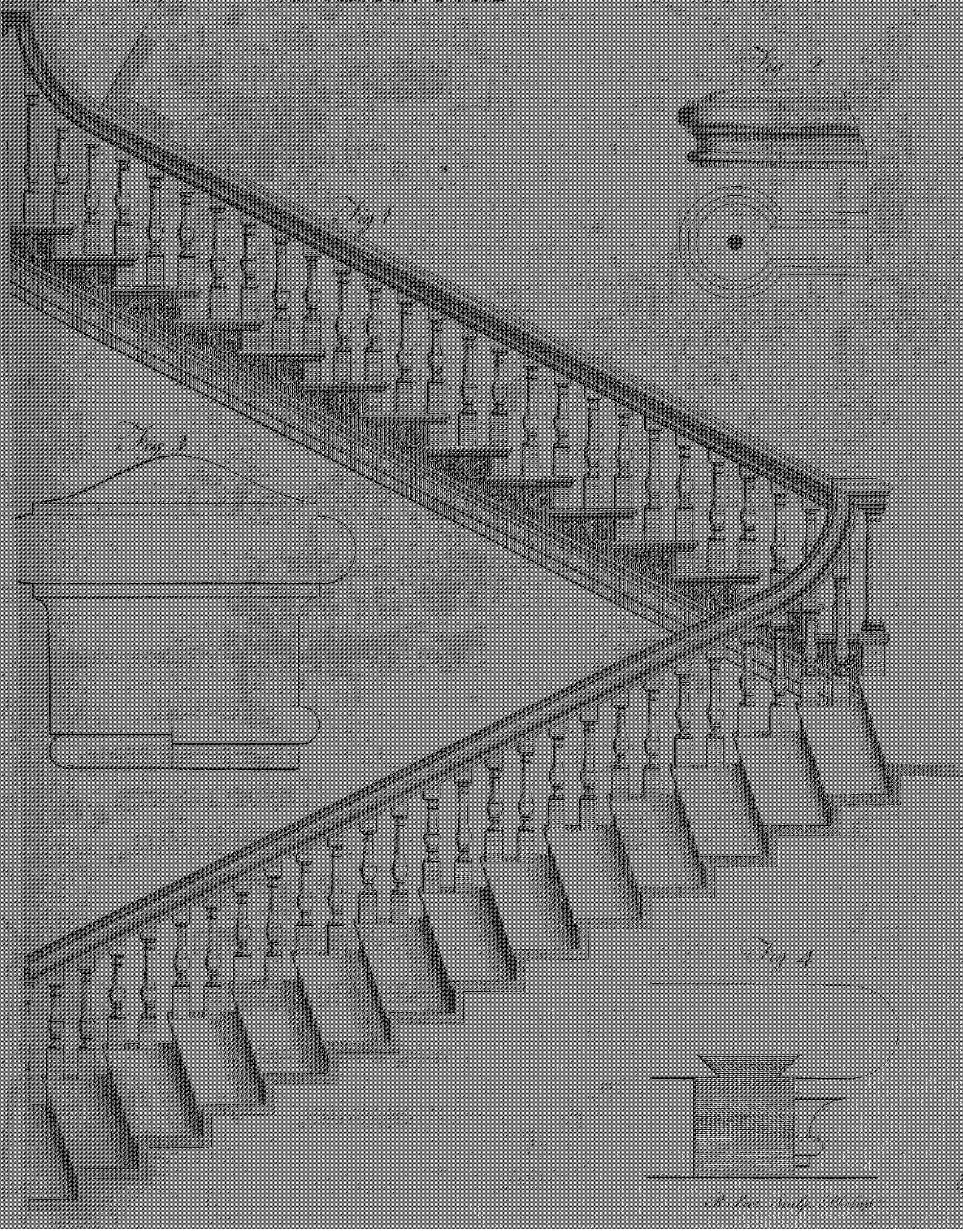
Having thus described and given rules for the most generally received proportions of the different parts of buildings, both of the useful and ornamental kind, we must next give an account of the method of erecting different kinds of edifices; and here the judgment of the architect must necessarily be very much employed, as no fixed rules have been laid down by which he can be directed in all cases. As a necessary preliminary, however, to the construction, we must first consider,

95 Chap. I. *The Situations of Houses.*

Though it must be, in many cases, impossible to chuse such a situation as might be agreeable either to the architect or the proprietor, yet where a choice can be made, there are certainly a great many circumstances that will determine one situation to be preferable to another. These circumstances depend entirely on the person who is to inhabit the house. A farmer, for instance, ough to dwell in the most centrical part of his farm; an independent gentleman must regard the healthiness, the neighbours with whom he can converse, the prospect from his house, and also the aspect of the ground near it. To answer these purposes of health and pleasure, an open elevated situation is the best, as the air is there pure, and the prospect extensive; but too elevated a situation is disagreeable, as being both difficult of access, and exposed to cold and bleak winds. To build in bottoms between hills is both unhealthful and unpleasant, the house being in a manner buried,



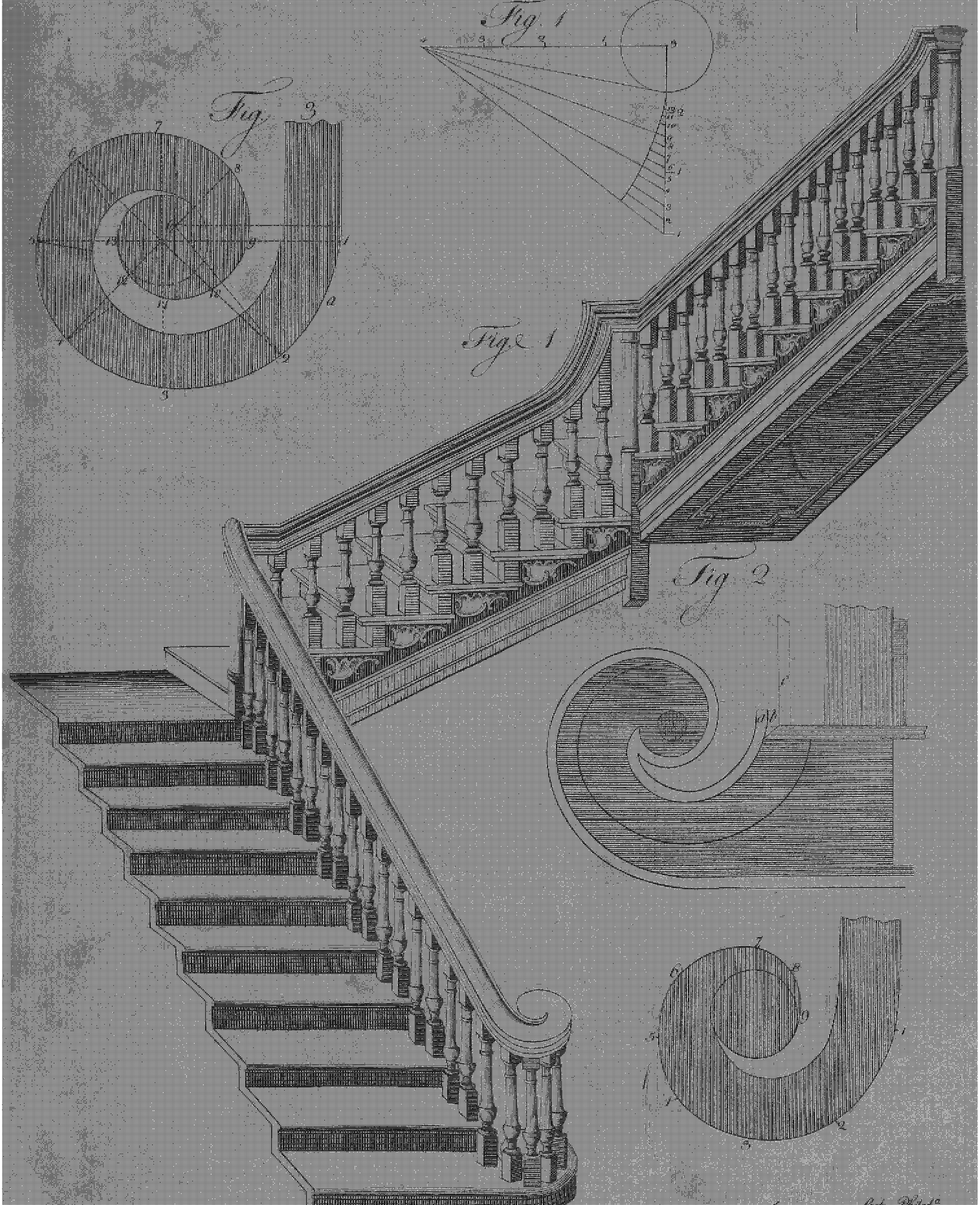
Thackara & Vallance Sculp.



R. Scot Sculp. Philad.

ARCHITECTURE

Plate XLIX



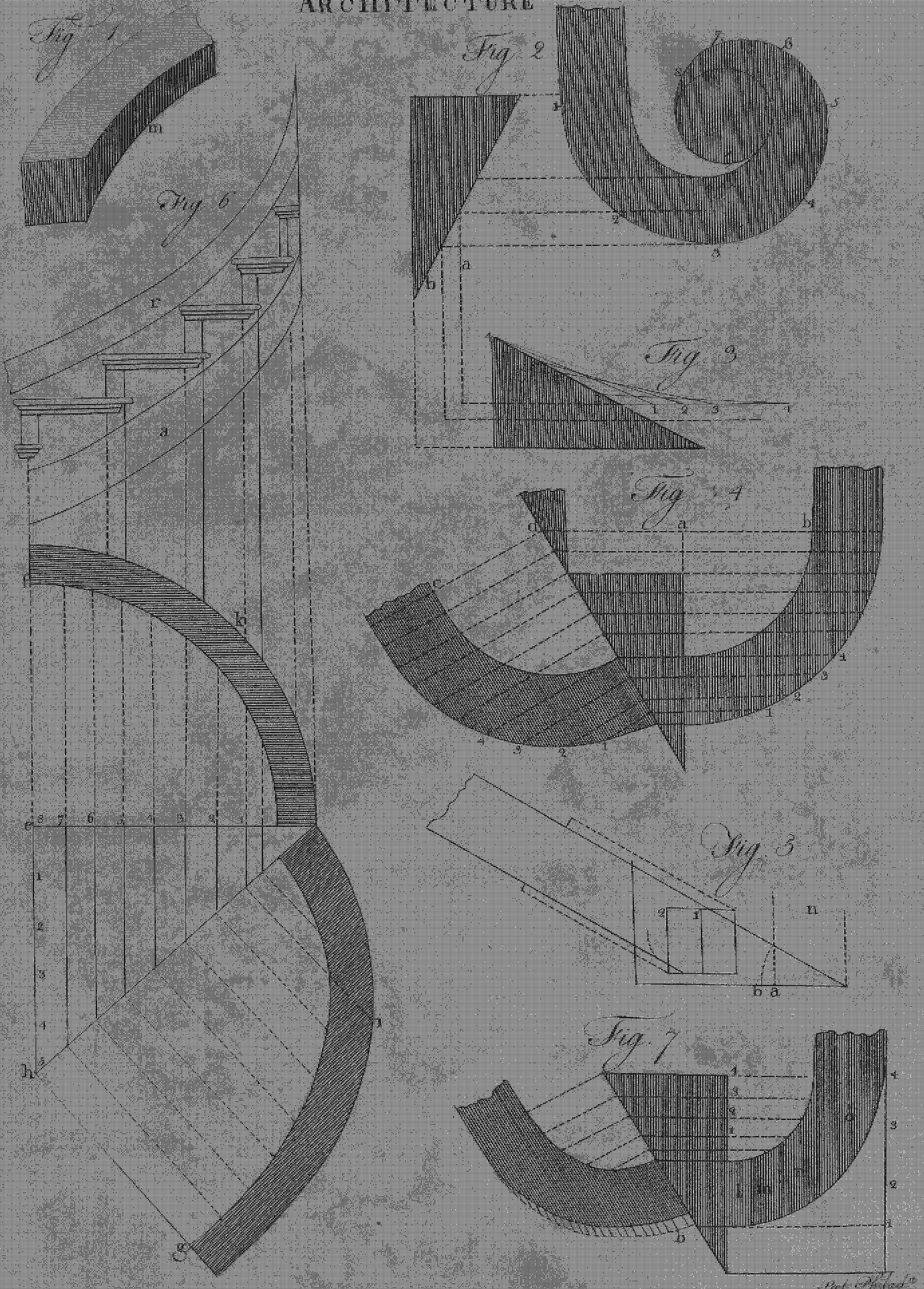
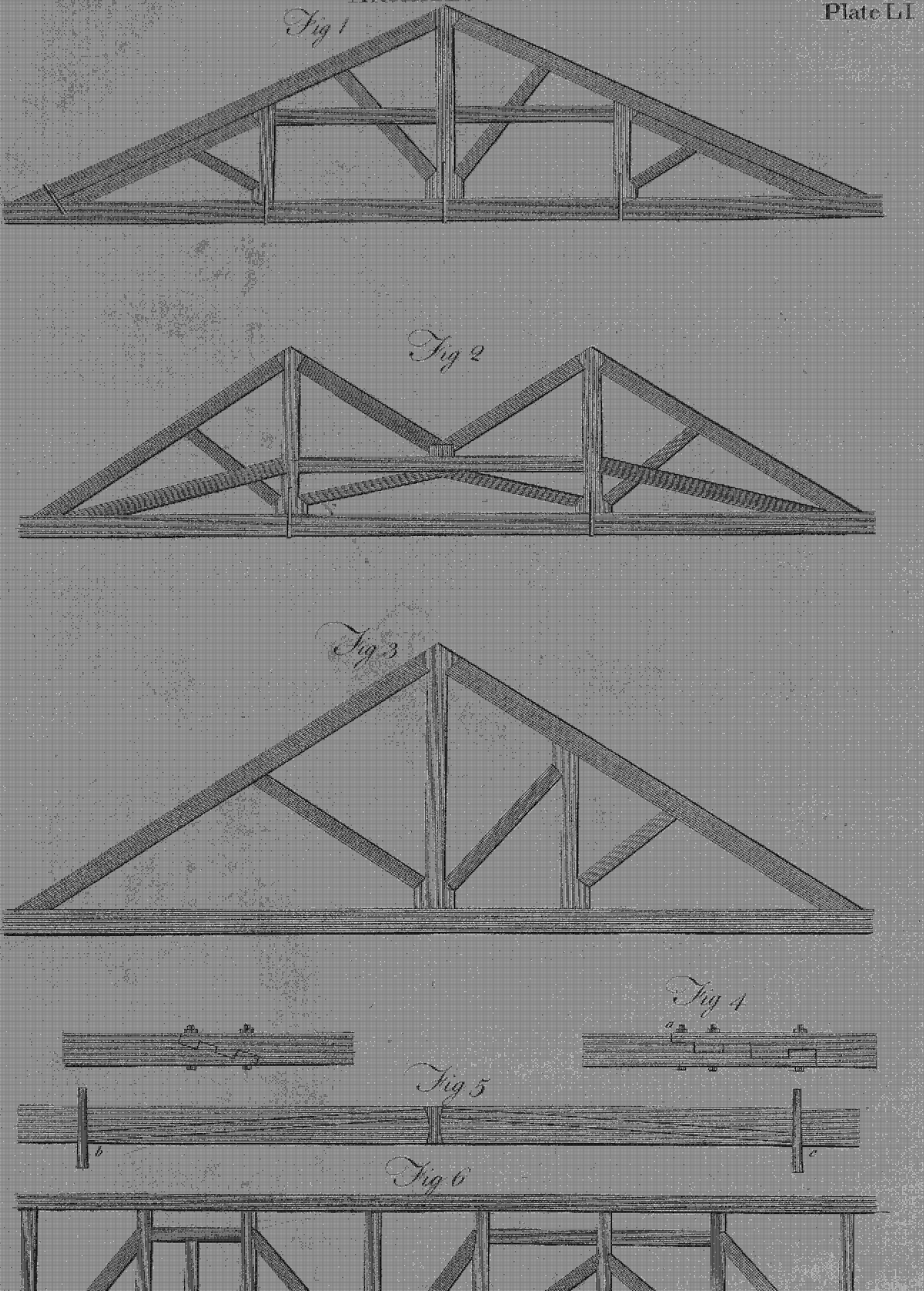


Fig. 1
Fig. 2
Fig. 3
Fig. 4
Fig. 5
Fig. 6
Fig. 7



Scot Philad.

buried, and the ground near it generally marſhy from the rain-water which runs down from the hills, which renders the air unwholeſome. As a garden alſo is a very neceſſary article to a country habitation, the ſoil is by no means a matter of indifference; and therefore it may be concluded, that an elevated ſituation on a gravelly loam, near ſome running water, is the beſt ſituation for a country houſe.

Chap. II. *Of the conſtruction of Edifices in general.*

The proper ſituation of a houſe, or any other building, being choſen, according to its intended nature, the next thing to be conſidered is to lay the foundation in a proper manner. The only ſecurity of a houſe, or any other building whatever, is in having a good foundation, and no error is ſo dangerous as that which is committed here; as the ſhrinking of the foundation but the breadth of a ſtraw may cauſe a rent of five or ſix inches wide in the ſuperſtructure. To guard againſt errors of this kind, the qualities of the ground for a conſiderable depth muſt be carefully obſerved.

96 Qualities of the ground neceſſary to be examined.

The beſt foundation is that which conſiſts of gravel or ſtone; but, in order to know whether the inferior ſtrata are ſufficient for the ſupport of the building, it will be adviſable to ſink wells at ſome little diſtance. By attending to what is thrown up in digging theſe, the architect will be acquainted with what lies under the ſtony or gravelly bed which on the ſurface promiſes ſo much ſecurity, and will know what meaſures to take.

97 Rocky ground ſometimes dangerous.

But though a ſtony or gravelly bottom is undoubtedly the moſt ſure and firm, where all is found beneath, there is no kind of ground which may prove more fallacious, or occaſion ſuch terrible accidents. The reaſon of this is, that ſuch kind of ground often contains abſolute vacuities; nor is rock itſelf, though a foundation upon a rock is ſtrong even to a proverb, free from dangers of the ſame kind. Caverns are very frequent in rocky places; and ſhould an heavy building be erected over one of theſe, it might ſuddenly fall down altogether. To guard againſt accidents of this kind, Palladio adviſes the throwing down great weights forcibly on the ground, and obſerving whether it ſounds hollow, or ſhakes; and the beating of a drum upon it, by the ſound of which an accuſtomed ear will know whether the earth is hollow or not.

Where the foundation is gravel, it will be proper to examine the thickneſs of the ſtratum, and the qualities of thoſe that lie under it, as they have appeared in digging. If the bed of gravel is thick, and the under ſtrata of a ſound and firm kind, there needs no aſſiſtance; if otherwiſe, we muſt have recourſe to various methods in order to ſupply the defect.

98 Sandy or boggy ground how managed.

The other matters which may occur for a foundation are clay, ſand, common earth, or rotten boggy ground. Clay will often both raiſe and ſink a foundation; yet it has a ſolidity which, with proper management, is very uſeful. The marſhy, rotten, or boggy ground is of all others the worſt; yet even upon this great buildings may be raiſed with perfect ſafety, provided proper care be taken. In caſe of boggy earths, or unfirm ſand, piling is one of the moſt common methods of ſecuring a foundation; and, notwithſtanding the natural diſadvantage of the earth, piles, when properly executed, are one of the firmeſt and moſt ſecure foundations.

99 Foundations near waters dangerous.

In foundations near the edge of waters, we ſhould always be careful to ſound to the very bottom, as many terrible accidents have happened from the ground being undermined by rivers. The ſame method is to be followed when the ground on which we build has been dug or wrought before. It ought never to be truſted in the condition in which it is left; but we muſt dig through it into the ſolid and unmoved ground, and ſome way into that, according to the weight and bigneſs of the intended edifice. The church of St Peter's at Rome is an inſtance of the importance of this laſt obſervation. That church is in great part built upon the old circus of Nero; and the builders having neglected to dig through the old foundation, the ſtructure is conſequently ſo much the weaker. The walls were judged of ſtrength enough to bear two ſteeples upon the corners of the frontiſpiece; but the foundation was found too weak when it was impoſſible to remedy the defect perfectly.

100 Defect in St Peter's at Rome.

Before the architect, however, begins to lay the foundation of the building, it will be proper to conſtruct ſuch drains as may be neceſſary for carrying off the rain, or other refuſe water that would otherwiſe be collected and lodge about the houſe. In making of drains for carrying off this water, it will be neceſſary to make large allowances for the different quantities that may be collected at different times. It muſt alſo be conſidered, that water of this kind is always loaded with a vaſt quantity of ſediment, which by its continual falling to the bottom will be very apt to choak up the drain, eſpecially at thoſe places where there happen to be angles or corners in its courſe. The only method of preventing this is by means of certain cavities diſpoſed at proper diſtances from one another. Into theſe the ſediment will be collected, and they are for that reaſon called *ſeſpools*. With regard to theſe, the only directions neceſſary are, that they be placed at proper diſtances, be ſufficiently large, and placed ſo as to be eaſily cleaned. It is a good rule to make a ſeſpool at each place where the water enters the drain; as by this means a conſiderable quantity of ſediment will be prevented from entering the channel at all. Others are to be made at proper diſtances, eſpecially where there are any angles. They muſt be made ſufficiently large; the bigger, in moderation, the better; and they muſt alſo be covered in ſuch a manner as to be eaſily got at in order to be cleaned. But, as putrid water is exceedingly noxious, it will be neceſſary to carry up a brick funnel over every ſeſpool, in order to prevent the collection of the putrid effluvia, which would otherwiſe occaſion the death of the perſon who cleaned it.

101 Drains how made.

102 Seſpools.

103 Proprotions of drains.

All drains ought to be arched over at top, and may be moſt conveniently built of brick. According to their different ſizes, the following proportions of height and thickneſs may be obſerved. If the drain is 18 inches wide, the height of the walls may be one foot, and their thickneſs nine inches; the bottom may be paved with brick laid flatwiſe, and the arch turned four inches. If the drain is 22 inches wide, the ſide walls are then to be one foot three inches in height, and the reſt conſtructed as before. If it is 14 inches wide, the height of the walls may be 9 inches, and the ſweep of the arch four. A drain of a yard wide ſhould have the

Practice. same height, and the arch turned over it ought to be 9 inches thick. Upon the same principles and proportions may other drains of any size be constructed.

104 Foundation of buildings how laid.

The sewers and drains being constructed in a manner proportioned to the size of the intended building, the architect may next proceed to lay the foundation of the walls. Here the first care must be, that the floor of the foundation be perfectly smooth and level. The Italians begin with laying over it an even covering of strong oak plank; and upon that they lay, with the most exact care, the first course of the materials. Whether we take this method, or begin upon the naked floor, all must be laid with the most exact truth by rule and line. When the board plat is laid, a course of stone is the best first bed, and this is to be laid without mortar; for lime would make the wood decay, which otherwise, in a tolerably good soil, will last for ages. After this, all the courses should follow with the same perfect evenness and regularity. If the materials are brick, they should be laid on with an equal, and not too great quantity of mortar: if stone, they ought to be placed regularly, and in the same situation in which they lay in the quarry: for many stones, which will bear any weight flatwise, and in their natural position, are of such a grain, that they will split otherwise. The joinings of the under course must be covered by the solid of the next course all the way up; and the utmost care must be taken that there be no vacuity left in the wall, for the weight will most certainly crush it in. The less mortar there is in a foundation, the better. Its use is to cement the bricks and stones together; and the evener they are, the less will be required for the purpose. Where mortar is used to fill up the cavities, it becomes part of the wall; and not being of equal strength with the solid materials, it takes from the firmness of the building. For the same reason, nothing can be more absurd, than to fill up a foundation with loose stones or bricks thrown in at random; and where this is done, the ruin of the building is inevitable. Where the foundation of a principal wall is laid upon piles, it will be necessary also to pile the foundations of the partitions, though not so strongly.

105 Thickness and diminutions of walls, &c.

The thickness of foundation-walls in general ought to be double that of the walls which they are to support. The looser the ground, the thicker the foundation-wall ought to be; and it will require the same addition also in proportion to what is to be raised upon it. The plane of the ground must be perfectly level, that the weight may press equally every where: for when it inclines more to one side than another, the wall will split. The foundations must diminish as they rise, but the perpendicular is to be exactly kept in the upper and lower parts of the wall; and this caution ought to be observed all the way up with the same strictness. In some ground, the foundation may be arched; which will save materials and labour, at the same time that the superstructure has an equal security. This practice is peculiarly serviceable where the foundation is piled.

106 Diminution of the thickness of walls.

As the foundation-walls are to diminish in thickness, so are those which are built upon them. This is necessary in order to save expence, but is not absolutely so to strengthen the wall; for this would be no less strong though it was continued all the way to the top of an equal thickness, provided the perpendicular was exactly kept. In this the ancients were very expert; for we see, in the remains of their works, walls thus carried up to an exorbitant height. It is to be observed, however, that, besides perfect truth in their perpendiculars, they never grudged iron work, which contributed greatly to the strength of their buildings. The thickness and diminution of walls is in a great measure arbitrary. In common houses built of brick, the general diminution from the bottom to the top is one-half the thickness at the bottom; the beginning is two bricks, then a brick and a half, and lastly one brick, thickness. In larger edifices, the walls must be made proportionally thicker; but the diminution is preserved much in the same manner. Where stones are used, regard must be had to their nature, and the propriety of their figures for holding one another. Where the wall is to be composed of two materials, as stone and brick the heaviest ought always to be placed undermost.

107 Angles how fortified.

There is one farther particular regarding the strength of a plain wall, and that is, the fortifying its angles. This is best done with good stone on each side, which gives not only a great deal of strength, but a great deal of beauty. Pilasters properly applied are a great strengthening to walls. Their best distance is about every 20 foot, and they should rise five or six inches from the naked of the wall. A much slighter wall of brick with this assistance, is stronger than a heavier and massier one built plain. In brick walls of every kind, it is also a great addition to their strength to lay some chief courses of a larger and harder matter; for these serve like sinews to keep all the rest firmly together, and are of great use where a wall happens to sink more on one side than another.

108 Windows improper near the corners.

As the openings in a wall are all weakenings, and as the corners require to be the strongest parts, there should never be a window very near a corner. Properly, there should always be the breadth of the opening firm to the corner. In the most perfect way of forming the diminution of walls, the middle of the thinnest part being directly over the middle of the thickest, the whole is of a pyramidal form; but where one side of the wall must be perpendicular and plain, it ought to be the inner, for the sake of the floors and cross walls. The diminished side, in this case, may be covered with a fascia or cornice, which will at once be a strength and ornament.

109 Chimneys.

Along with the construction of walls, that of the chimneys must also considered; for errors in the construction of these will render the most elegant building extremely disagreeable. The common causes of smoaking are either that the wind is too much let in above at the mouth of the shaft, or the smoke is stifled below: and sometimes a higher building, or a great elevation of the ground behind, is the source of the mischief; or lastly, the room in which the chimney is, may be so small or close, that there is not a sufficient current of air to drive up the smoke. Almost all that can be done, while the walls are constructing, to prevent smoke, is, to make the chimney vent narrower at bottom than at top: yet this must not be carried to an extreme; because the smoke will then linger in the upper part, and all the force of the draught will not be able to send it up.—As for the methods of curing smoky chimneys in houses already built, see the article CHIMNEY.

After

Fig. 1.

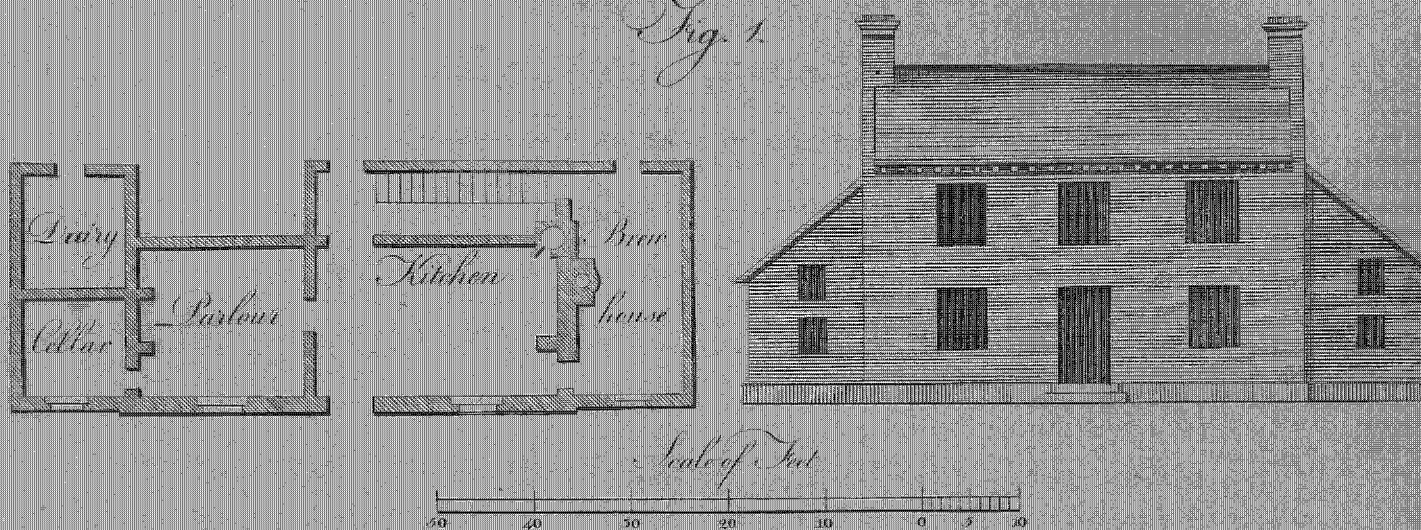
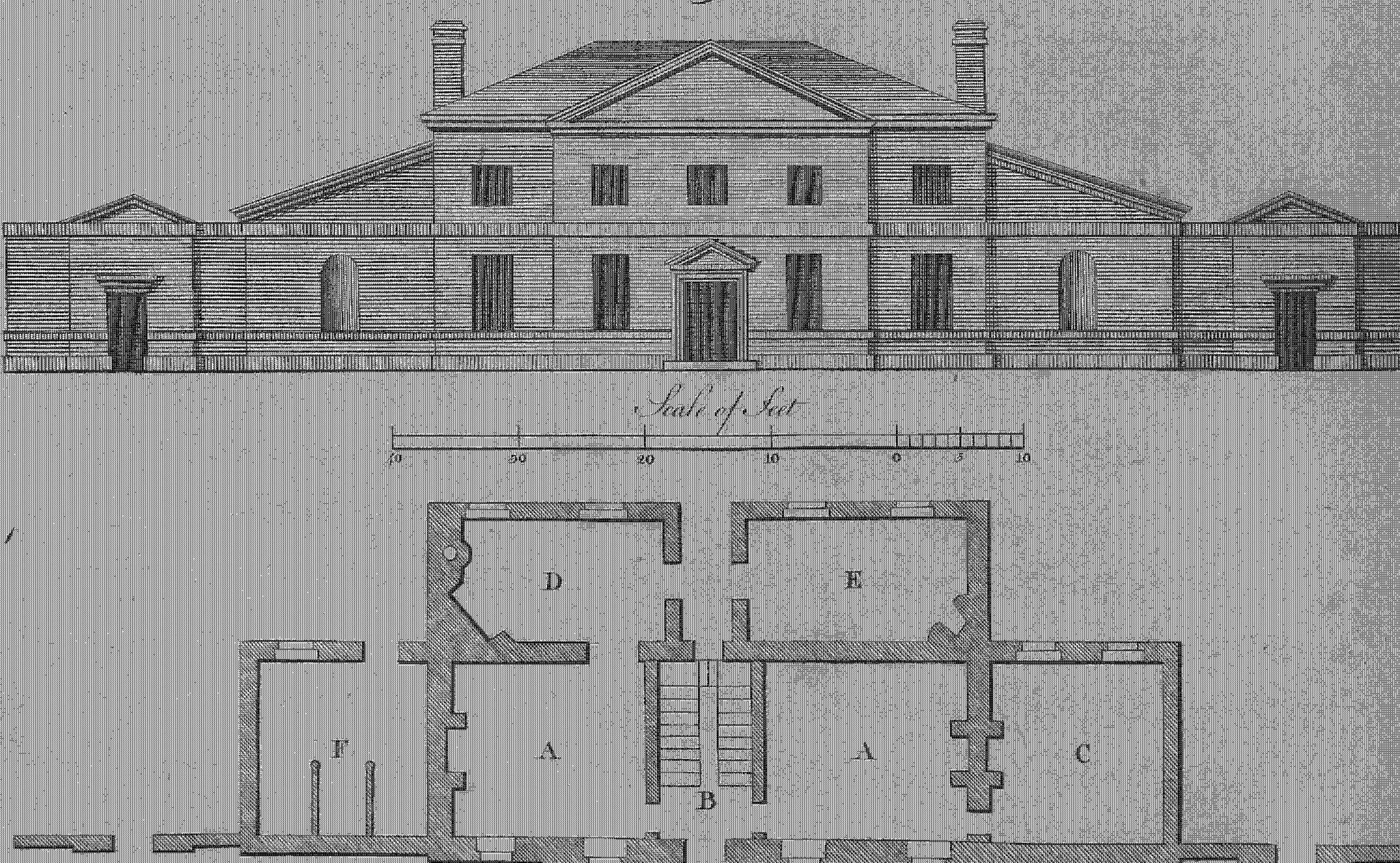


Fig. 2.



AA are two Parlours 15 feet. D Kitchen
B Stair Case. E Wash house } are Shades
C Study. F Stable.

Thackara & Vallance, Sculp.

Practice.

117 Roofs. After the walls are finished, the roof is the next consideration: but concerning it very little can be said; only that its weight must be proportioned to the strength of the walls. It must also be so contrived as to press equally upon the building; and the inner walls must bear their share of the load as well as the outer ones. A roof ought neither to be too massy nor too light; as being necessary for keeping the walls together by its pressure, which it is incapable of doing while too light; and if too heavy, it is in danger of throwing them down. Of these two extremes, however, the last is to be accounted the worst.

117 Floors. With regard to the floors, they are most commonly made of wood; in which case, it will be necessary that it should be well seasoned by being kept a considerable time before it is used. The floors of the same story should be all perfectly on a level; not even a threshold rising above the rest: and if in any part there is a room or closet whose floor is not perfectly level, it ought not to be left so, but raised to an equality with the rest; what is wanting of the true floor being supplied by a false one.

In mean houses, the floors may be made of clay, ox blood, and a moderate portion of sharp sand. These three ingredients, beaten thoroughly together and well spread, make a firm good floor, and of a beautiful colour. In elegant houses, the floors of this kind are made of plaster of Paris, beaten and sifted, and mixed with other ingredients. This may be coloured to any hue by the addition of proper substances; and, when well worked and laid, makes a very beautiful floor. Besides these, halls, and some other ground-rooms, are paved or floored with marble or stone; and this either plain or dotted, or of a variety of colours: but the universal practice of carpeting has in a great measure set aside the bestowing any ornamental workmanship upon floors. In country buildings, also, floors are frequently made of bricks and tiles. These, according to their shapes, may be laid in a variety of figures; and they are also capable of some variation in colour, according to the nature of the earth from which they were made. They may be laid at any time; but for those of earth or plaster, they are best made in the beginning of summer, for the sake of their drying.

Chap. III. *Of the Distribution of the Apartments of Houses, with other conveniences.*

As houses are built only for the sake of their inhabitants, the distribution of the apartments must of necessity be directed by the way of life in which the in-
118 Plan of a farm-house. habitants are engaged. In the country, this is commonly farming; and here, besides the house for the family, there is also necessary a barn for the reception of the produce of the ground, a stable for cattle, a cart-house for keeping the utensils under cover, and sheds for other uses.—To accomplish these purposes, let a piece of ground be taken of five times the extent of the front of the house, and inclosed in the least expensive manner. Back in the centre of this let the house be placed, and in the front of the ground the barn and the stable, with the adjoining sheds. These are to be set, one on each side, to the extreme measure of the inclosed ground: they will thus fill up a part of the entrance, and will leave all about the house some inclosed ground by way of yard. From the barn to the stable may be extended a fence with a gate in the middle, and this gate ought to front the door of the house.

This much being settled, the plan of the house and out-buildings may be made as follows. The door may open into a plain brick passage, at the end of which may be carried up a small stair-case. On one side of the passage may be a common kitchen; and on the other side a better or larger room, which will serve the family by way of parlour. Beyond this may stand on one side the pantry, and on the other the dairy room, the last being twice the size of the former. They are placed on the same side with the parlour, on account of the heat of the kitchen, which renders it improper to be near them. On the kitchen side, a brew-house may very conveniently be placed. More rooms may be added on the ground-floor as occasion requires; and the upper story is to be divided into bed-chambers for the family, with garrets over them for the servants.—A house of this kind is represented Plate LII. fig. 1.; and one of a somewhat better kind fig. 2. where a private gentleman who has a small family may find conveniency.

119 Of an elegant country seat. On Plate LIII. is represented a gentleman's country-seat, built on a more elegant plan. Here the front may extend 65 feet in length, the depth in the center being 40 feet, and in each of the wings 45. The offices may be disposed in wings; the kitchen in the one, and the stables in the other; both of which, however, may correspond in their front with the rest of the building, which they ought also to do with one another. These wings may have a projection of 13 feet from the dwelling-house, to which they ought to be connected, not by straight lines, but by curves, as represented fig. 2.

The best proportion of these offices to a house extending 65 feet in front, is 35 feet. If they are smaller, the house will look gigantic; if larger, they will lessen its aspect. To a front of 35 feet, a depth of 48 is a very good proportion. There ought also to be a covered communication between the dwelling-house and offices, which must not appear only to be a plain blank wall, but must be ornamented with gates, as in the figure. The arch by which the offices are joined to the dwelling-house must be proportioned to the extent of the buildings; and there cannot be a better proportion than five feet within the angles of the buildings. By this means the wings, which have only a projection of 13 feet, will appear to have one of 18, and the light will be agreeably broken.

With regard to the internal distribution of a house of this kind, the under story may be conveniently divided into three rooms. The hall, which is in the centre will occupy the whole of the projecting part, having a room on each side. The length of the hall must be 24 feet, and its breadth 12: the rooms on each side of it must be 16 feet long, and 11 wide. Of these two front rooms, that on the right hand may be conveniently made a waiting-room for persons of better rank, and that on the left hand a dressing-room for the master of the house. Behind the hall may run a passage of four feet and an half, leading to the apartments in the hinder part of the house and the stair-case. These may be disposed as follows. Directly behind the hall and this passage, the space may be occupied by a saloon, whose length is 24 feet and its breadth 17. On the left hand of the passage, behind the hall, is to be placed the grand stair-case; and as it will not fill the whole depth, a pleasant common parlour may terminate on that side of the house. On the other side, the passage is to lead to the door of the great dining parlour, which may occupy the whole space.

120 Another.

A plan of a house of the same kind, but somewhat different in the distribution, is represented below in the same plate. The front here extends 68 feet, and the wings project 28 feet; their depth is 48, and their breadth 36. The hall may be 26 feet long and 17 broad. On the left hand of the hall may be a waiting-room 16 feet long and 10 broad; behind which may be a handsome dining-room. The passage into this waiting-room should be at the lower end of the hall; and it must have another opening into the room behind it. On the right hand of the hall is the place of the great stair-case, for which a breadth of 16 feet three inches is to be allowed. In the centre of the building, behind the hall, may be a drawing-room 26 feet long and 16 broad; and behind the stair-case will be a room for a common parlour of 16 feet square. The passage of communication between the house and wings may be formed into colonnades in a cheap manner behind: a flight of steps, raised with a sweep, occupying the centre of each, and leading up to a door, and the covering being no more than a shed supported by the plainest and cheapest columns.

The two wings now remain to be disposed of. That on the right hand may contain the kitchen and offices belonging to it, and the other the stables. The front of the right-hand wing may by occupied by a kitchen entirely, which will then be 30 feet long and 16½ wide; or it may be made smaller, by setting off a small room to the right. Twenty-two feet by 16 will then be a good bigness. The other room will then have the same depth of 16 feet, and the width to the front may be 7½. Beyond the kitchen may stand the stair-case, for which 7½ feet will be a proper allowance; and to the right of this may be a scullery 12 feet 10 inches deep from the back front by 7 in breadth. To the left of the stair may be a servants hall 16 feet square, and behind that a larder 12 feet 10 by 14 feet 6. In the centre of the other wing may be a double coach-house: for which there should be allowed the whole breadth of the wing, with 10 feet 6 inches in the clear; and on each side of this may be the stables. The external decorations of the front and wings will be better understood from the figure than they can be by any description.

121 Of the Eral of Wemyss's house.

Plate LIV. shows the plan and elevation of the house of the Earl of Wemyss at Newmills. The proportions of the rooms are marked in the plan; and the front, being decorated with columns of the Ionic order, will sufficiently show in what manner any of the five orders may be induced with propriety and elegance.

Chap. IV. *Of Aquatic Buildings.*

1. Of Bridges.

122

These are constructed either of wood or stone; of which the last are evidently the strongest and most durable, and therefore in all cases to be preferred where the expence of erecting them can be borne. The proper situation for them is easily known, and requires no explanation; the only thing to be observed is, to make them cross the stream at right angles, for the sake of the boats that pass through the arches, with the current of the river; and to prevent the continual striking of the stream against the piers, which in a long course may endanger their being damaged and destroyed in the end.

Bridges built for a communication of high roads, ought to be so strong and substantial as to be proof against all accidents that may happen, to have a free entrance for carriages, afford an easy passage to the waters, and be properly adapted for navigation, if the river admits of it. Therefore the bridge ought to be at least as long as the river is wide in the time of its greatest flood: because the sloping of the waters above may cause too great a fall; which may prove dangerous to the vessels, and occasion the under graveling the foundation of the piers and abutments; or, by reducing the passage of the water too much in time of a great flood, it might break though the banks of the river, and overflow the adjacent country, which would cause very great damages; or if this should not happen, the water might rise above the arches, and endanger the bridge to be overset, as has happened in many places.

When the length of the bridge is equal to the breadth of the river, which is commonly the case, the current is lessened by the space taken up by the piers: for which reason this thickness should be no more than is necessary to support the arches; and it depends, as well as that of the abutments, on the width of the arches, their thickness, and the height of the piers.

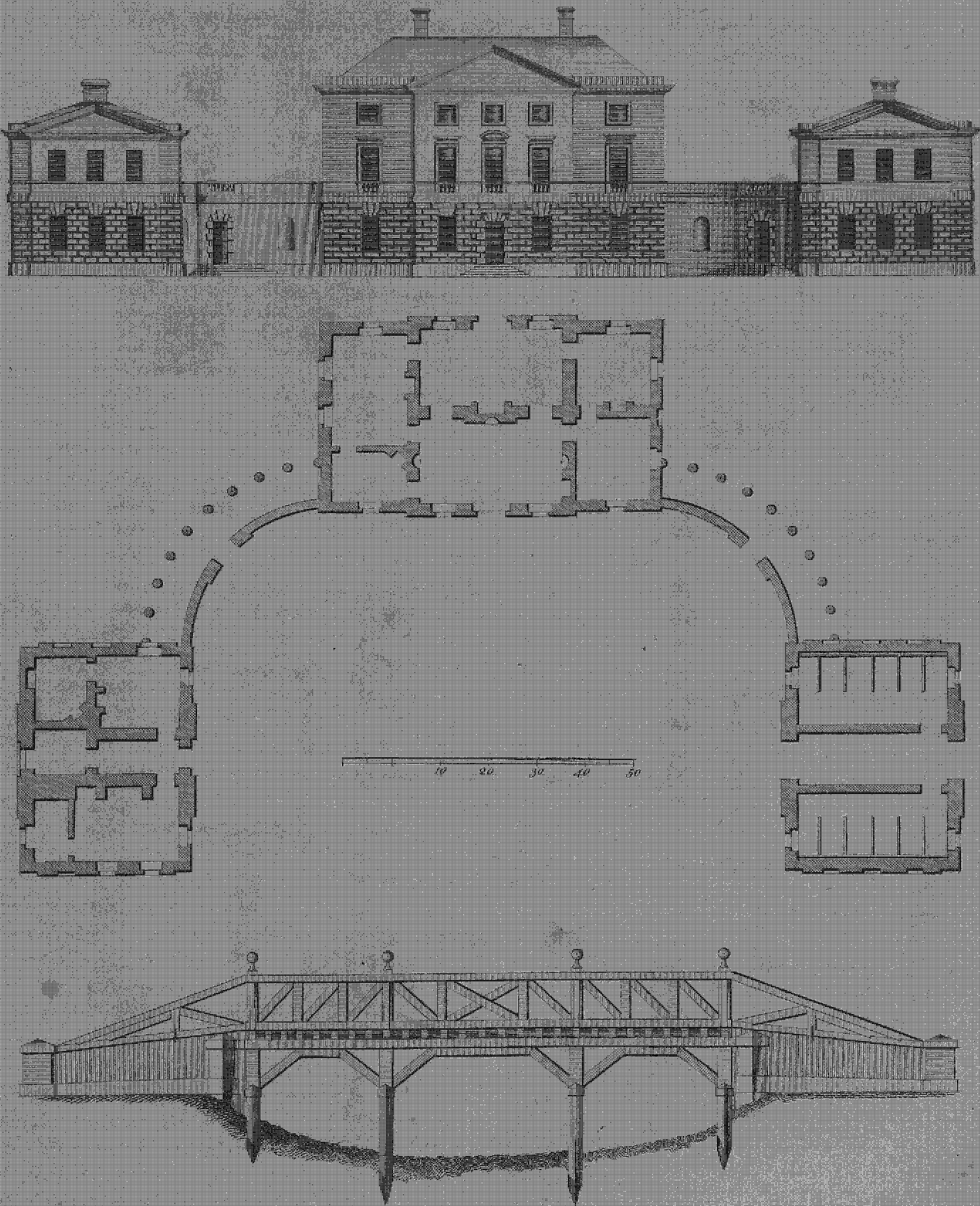
123 Proper form of arches.

The form of the arch is commonly semicircular; but when they are of any great width, they are made elliptical, because they would otherwise become too high. This has been done at the Pont Royal at Paris, where the middle arch is 75 feet, and its height would have been 37.5 feet, instead of which it is only 24 by being made elliptical.

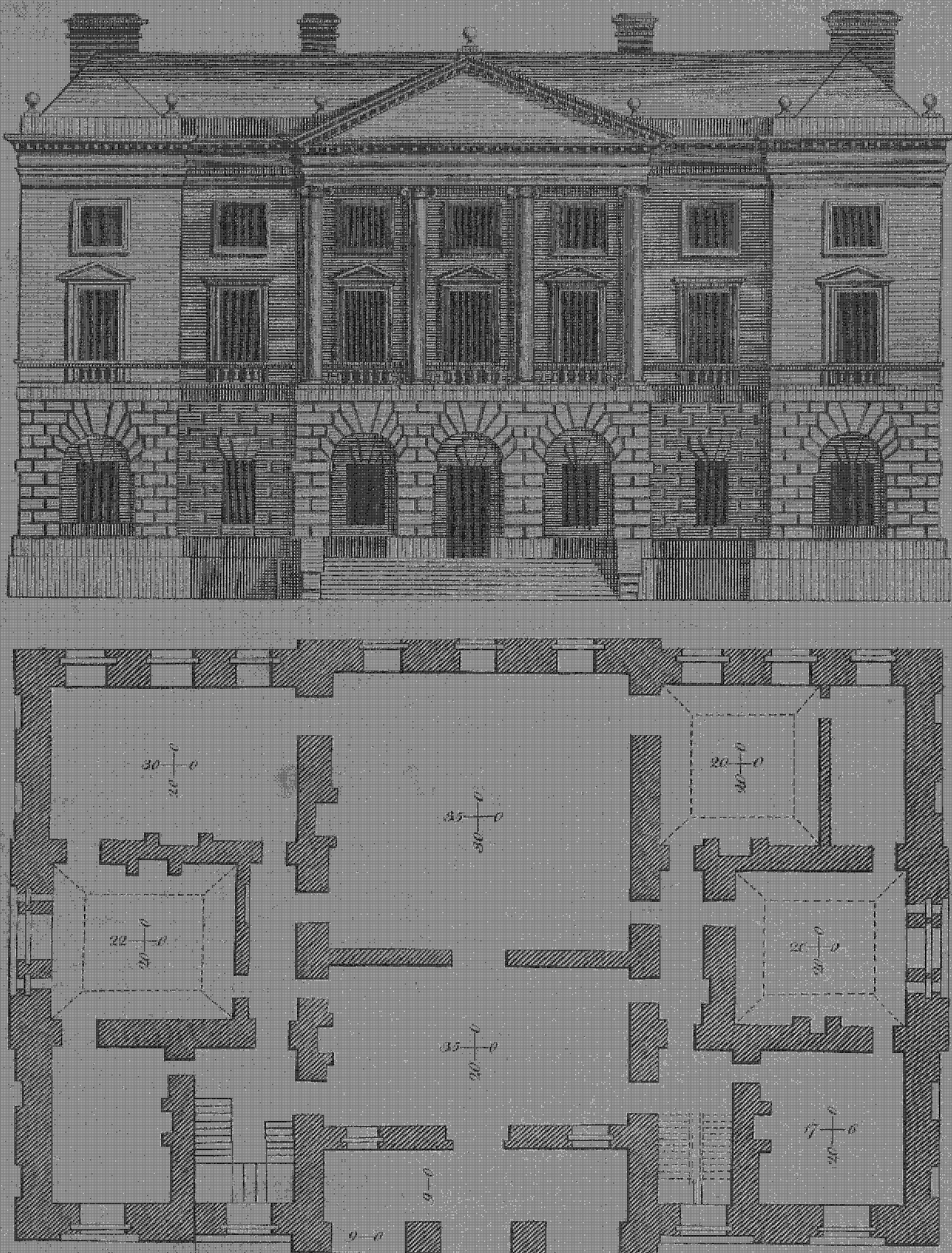
Another advantage of much more importance arises from the oval figure, which is, that the quantity of masonry of the arches is reduced in the same proportion as the radius of the arch is to its height. That is, if the radius is 36 feet, and the height of the arch 24, or three-fourths of the radius, the quantity of masonry of the arches is likewise reduced to three-fourths; which must lessen the expence of the bridge considerably. Notwithstanding these advantages, however, the latest experiments have determined segments of circles to be preferable to curves of any other kind; and of these the semicircle is undoubtedly the best, as pressing most perpendicularly on the piers.

When the height of the piers is about six feet, and the arches are circular, experience has shown, says Mr Belidor,

Architecture



R. Scot Sculp. Philad.a



Thackara & Vallance, Sculp.

 Belidor, that it is sufficient to make the thickness of the piers the sixth-part of the width of the arch, and two feet more; that is, the thickness of the piers of an arch of 36 feet, ought to be 8 feet; those of an arch of 48 feet, to be 10.

124 Thickness of the piers. When the arches are of a great width, the thickness of the piers may be reduced to the sixth-part of that width; but the depression of the two feet is not done at once; that is, in an arch above 48 feet, 3 inches are taken off for every 6 feet of increase of the width of the arch. For instance, the thickness of the piers supporting an arch of 72 feet wide, should be 14 feet, according to the preceding rule; but by taking off 3 inches for every six feet, above an arch of 48 wide, the thickness of the piers is reduced to 13 feet: consequently, by following the same rule, the thickness of the piers supporting an arch of 16 fathoms wide, will be 16 feet; all the others above that width are the sixth-part of the width.

After this, Mr Belidor gives a rule for finding the thickness of the piers which support elliptic arches, and makes them stronger than the former: the abutments he makes one-sixth part more than the piers of the largest arch. But it is plain that these rules are insufficient, being merely guess-work, determined from some works that have been executed.

125 Of the arch stones. The thickness of the arch-stones is not to be determined by theory, nor do those authors who have written on the subject agree amongst themselves. Mr Gautier, an experienced engineer, in his works, makes the length of the arch-stones, of an arch 24 feet wide, 2 feet; of an arch 45, 60, 75, 90 wide, to be 3, 4, 5, 6, feet long respectively, when they are hard and durable, and something longer when they are of a soft nature: on the contrary, Mr Belidor says, they ought to be always one twenty-fourth part of the width of the arch, whether the stone be hard or soft; because, if they are soft, they weigh not so much.

But that the length of the arch-stones should be but a foot in an arch of 24 feet wide, 2, 3, 4, in arches of 48, 72, 96 feet, seems incredible; because the great weight of the arches would crush them to pieces, by the pressure against one another; and therefore Mr Gautier's rule appears preferable: as he made the length of the arch-stones to increase in a slower proportion, from 10 to 45 feet wide, than in those above that width, we imagine that the latter will be sufficient for all widths, whether they are great or little: therefore we shall suppose the length of the arch-stones of 30 feet in width to be two feet, and to increase one foot in 15; that is, 3 feet in an arch of 45 feet; 4, 5, 6, in an arch of 60, 75, and 90 feet: and so the rest in the same proportion.

Table containing the thickness of piers of bridges.

	6	90	12	15	18	21	24
20	4.574	4.918	5.165	3.350	5.492	5.610	5.698
25	5.490	5.913	6.216	6.455	6.645	6.801	7.930
30	6.386	6.816	7.225	7.513	7.746	7.939	8.102
35	7.258	7.786	8.200	8.532	8.807	9.037	9.233
40	8.404	8.691	9.148	9.523	9.835	10.101	10.328
45	8.965	9.579	10.077	10.489	10.837	11.136	11.394
50	9.805	10.454	10.987	11.435	11.817	12.146	12.434
55	10.640	11.245	11.882	12.364	13.019	13.149	13.218
60	11.400	12.110	12.718	13.281	13.723	14.109	14.314
65	12.265	13.025	13.648	14.185	14.654	15.082	15.433
70	13.114	13.869	14.517	15.049	15.573	16.011	16.400
75	14.000	14.705	15.336	15.965	16.480	16.940	17.354
80	14.747	15.542	16.234	16.842	17.381	17.864	18.298
85	15.513	16.328	17.041	17.674	18.237	18.742	19.198
90	16.373	17.201	17.929	18.578	19.157	19.679	20.152
95	17.184	17.826	18.772	19.438	20.036	20.577	21.068
100	17.991	18.848	19.610	20.293	20.908	21.466	21.976

The first horizontal line expresses the height of the piers in feet, from 6 to 24 feet, each increasing by 3; the first vertical column, the width of arches from 20 to 100 feet, for every five feet. 125 Explanation of the table.

The other columns express the thickness of piers in feet and decimals, according to the respective height at the head of the column, and the width of the arch against it in the first column.

Thus, for example, let the width of the arch be 60 feet, and the height of the piers 12; then the number 12.718, under 12, and against 60, expresses the thickness of the piers, that is 12 feet and 8.6 inches: we must observe again, that the length of the key-stone is 2 feet in an arch of 30 feet wide 3, 4, 5, 6, in an arch of 45, 60, 75, 90; that of 20 feet wide, 1 foot four inches; and the length of any other width is found by adding 4 inches for every 5 feet in width.

As this table contains the thicknesses of piers in respect to arches that are commonly used in practice, we imagined, that to carry it farther would be needless; because the difference between the thickness of the piers of any contiguous arches being but small, those between any two marked here, may be made equal to half the sum of the next below and above it: thus the thickness of the piers of an arch 52 or 53 feet wide is nearly equal to 10.222, half the sum of the thicknesses 9.805 and 10.64 of the arches 50 and 55 feet wide, when the height of the piers is 6 feet.

127 Form of piers. Rectangular piers are seldom used but in bridges over small rivers. In all others, they project the bridge by a triangular prism, which presents an edge to the

 stream,

ſtream, in order to divide the water more eaſily, and to prevent the ice from ſheltering there, as well as veſſels from running foul againſt them: that edge is terminated by the adjacent ſurfaces at right angles to each other at Weſtminſter-bridge, and make an acute angle at the Pont Royal of about 60 degrees; but of late the French terminate this angle by two cylindric ſurfaces, whoſe baſes are arcs 60 degrees, in all their new
128 bridges.

Slope of the bridge on each ſide.

When the banks of the rivers are pretty high, the bridge is made quite level above, and all the arches of an equal width: but where they are low, or for the ſake of navigation a large arch is made in the middle of the ſtream, then the bridge is made higher in the middle than at the ends: in this caſe, the ſlope muſt be made eaſy and gradual on both ſides, ſo as to form above one continued curve line, otherwiſe it appears diſagreeable to the eye. Mr Belidor will have the deſcent of that ſlope to be one twenty-fourth part of the length: but this is undoubtedly too much, as one-fiftieth part
129 of the length is quite ſufficient for the deſcent.

Width, &c.

The width commonly allowed to ſmall bridges is 30 feet: but in large ones near great towns, theſe 30 feet are allowed clear for horſes and carriages, beſides a banquet at each ſide for foot paſſengers of 6 to 9 feet each, raiſed about a foot above the common road; the parapet-walls on each ſide are about 18 inches thick and 4 feet high · they generally project the bridge with a corniſh underneath; ſometimes balluſtrades of ſtone or iron are placed upon the parapet, as at Weſtminſter; but this is only practiſed where a bridge of a great length is made near the capital of a country.

The ends of bridges open from the middle of the two large arches with two wings, making an angle of 45 degrees with the reſt, in order to make their entrance more free and eaſy: theſe wings are ſupported by the ſame arches of the bridge next to them being continued in the manner of an arch, of which one pier is much longer than the other.

How the work is to be carried on.

130 Methods of laying the foundation

As the laying the foundation of the piers is the moſt difficult part of the whole work, it is neceſſary we ſhould begin with an eaſy caſe, that is, when the depth of the water does not exceed 6 or 8 feet; and then proceed
131 to thoſe which may happen in a greater depth of water.

By batardeaus.

One of the abutments with the adjacent piers is incloſed by a dyke called *batardeau* by the French, of a ſufficient width for the work, and room for the workmen. This batardeau is made by driving a double row of piles, whoſe diſtance is equal to the depth of water, and the piles in each row are 3 feet from each other; they are faſtened together on the outſide by bonds of 6 by 4 inches: this being done, frames of about 9 feet wide are placed on the inſide to receive the boards which are to form the incloſure: the two uprights of theſe frames are two boards of an inch and half thick, ſharpened below to be driven into the ground, and faſtened together by double bonds, one below and the other above, each ſeparated by the thickneſs of the uprights; theſe bonds ſerve to ſlide the boards between: after theſe frames have been driven into the ground as hard as can be, then the boards themſelves are likewiſe driven in till they reach the firm ground underneath.

Between every two piles tie-beams are faſtened to the bonds of the piles, to faſten the inſide wall to the outſide one; theſe tie-beams are let into the bonds and bolted to the adjacent piles: this being done, the bottom is cleared from the looſe ſand and gravel, by a machine like thoſe uſed by ballaſt-heavers; and then well prepared clay is rammed into this coffer very tight and firm, to prevent the water from oozing through.

Sometimes theſe incloſures are made with piles only driven cloſe to each other; at others, the piles are notched or dove-tailed one into the other; but the moſt uſual method is to drive piles with grooves in them, 5 or 6 feet diſtant from each other, and boards are let down between them.

This being done, pumps and other engines are uſed to draw the water out of the incloſures, ſo as to be quite dry; then the foundation is dug, and the ſtones are laid with the uſual precautions, obſerving to keep ſome of the engines always ſtanding, in order to draw out the water that may ooze through the batardeau.

The foundation being cleared, and every thing ready to begin the work, a courſe of ſtones is laid; the outſide all round with the largeſt ſtretchers and headers that can be had, and the inſide filled with aſhlers well jointed, the whole laid in terraſs mortar: the facings are crampt together, and ſet in lead; and ſome cramps are alſo uſed to faſten the facings with the inſide. The ſame manner is to be obſerved throughout all the courſes to the height of low-water mark; after which the facings alone are laid in terraſs mortar, and the inſide with the beſt of the common ſort. When the foundation is carried to the height of low-water mark, or to the height where the arches begin, then the ſhaft or middle wall is to be carried up nearly to the height of the arches, and there left ſtanding till all the piers are finiſhed, in order that the maſonry may be ſufficiently dry and ſettled before the arches are begun. 132

Proper form of the baſe.

As the piers end generally with an arch at each end, it is cuſtomary to lay the foundation in the ſame manner: which is not ſo well as to continue the baſe rectangular quite to the ends of the piers, and as high as low-water mark; both becauſe the foundation becomes then ſo much broader, and alſo becauſe the water will not be able to get under it: for when the current ſets againſt a flat ſurface, it drives the ſand and mud againſt it ſo as to cover it entirely; whereas if a ſharp edge be preſented to the ſtream, it carries every thing away, and expoſes the foundation to the continual action of the water, which in courſe of time muſt deſtroy it.

After the intervals between the arches are filled up with ſtones laid in a regular manner without mortar, and the gravel is laid over them; two drains or gutters are to be made lengthwiſe over the bridge, one on each ſide next to the foot-path, about 6 feet wide and a foot deep; which being filled with ſmall pebble ſtones, ſerve to carry off the rain-water that falls on the bridge, and to prevent its filtering through the joints of the arches, as often happens. 133

Method of building with coffers, as was practiſed at Weſtminſter bridge.

The former method of laying the foundation by means of batardeaus is very expenſive, and often meets with great difficulties: for when the depth of water is 8 feet or more, it is ſcarcely poſſible to make the batardeaus ſo tight as to prevent the water from oozing through them; and in that caſe the number of engines required, as well as the hands to work them, become very extenſive; and if part of the batardeau ſhould break

break by some extraordinary wind or tide, the workmen would be exposed to very great danger.

The next and best method therefore is to build with coffers, when it is practicable, such as were used at Westminster bridge. Here the height of water was 6 feet at a medium when lowest, and the tide rose about 10 feet at a medium also: so that the greatest depth of water was about 16 feet. At the place where one of the piers of the middle or great arch was to be, the workmen began to drive piles of about 13 or 14 inches square, and 34 feet long, shod with iron, so as to enter into the gravel with more ease, and hooped above to prevent their splitting in driving them: these piles were driven as deep as could be done, which was 13 or 14 feet below the surface of the bed of the river, and 7 feet distant from each other, parallel to the short ends of the pier, and at about 30 feet distant from them: the number of these piles was 34, and their intent to prevent any vessels or barges from approaching the work; and in order to hinder boats from passing between them, booms were placed so as to rise and fall with the water.

This being done, the ballast-men began to dig the foundation under the water, of about 6 feet deep, and 5 wider all round than the intended coffer was to be, with an easy slope to prevent the ground from falling in: in order to prevent the current from washing the sand into the pit, short grooved piles were driven before the two ends and part of the sides, not above 4 feet higher than low-water mark, and about 15 feet distant from the coffer: between these piles rows of boards were let into the groves down to the bed of the river, and fixed there.

The bottom of the coffer was made of a strong grate, consisting of two rows of large timbers, the one longwise, and the other crosswise, bolted together with wooden trunnels ten feet wider than the intended foundation. The sides of the coffer were made of fir timbers laid horizontally close one over another, pinned with oaken trunnels, and framed together at the corners, excepting at the two saliant angles, where they were secured with proper irons, so that the one-half might be loosened from the other if it should be thought necessary; these sides were lined on the inside as well as on the outside with three-inch planks placed vertically; the thickness of those sides was 18 inches at the bottom, reduced to 15 above, and they were 16 feet high; besides, knee timbers were bolted at the angles, in order to secure them in the strongest manner. The sides were fastened to the bottom by 28 pieces of timber on the outside, and 18 within, called *straps*, about 8 inches broad, and 3 or four inches thick, reaching and lapping over the ends of the sides: the lower part of these straps had one side cut dove-tail fashion, in order to fit the mortises made near the edge of the bottom to receive them, and were kept in their places by iron wedges, which being drawn out when the sides were to be taken away, gave liberty to clear the straps from the mortises.

Before the coffer was launched, the foundation was examined, in order to know whether it was level; for which purpose several gauges were made, each of which consisted of a stone of about 15 inches square and three thick, with a wooden pole in the middle of about 18 feet long. The foundation being levelled and the coffer fixed directly over the place with cables fastened to the adjacent piles, the masons laid the first course of the stones for the foundation within it; which being finished a sluice made in the side was opened near the time of low water; on which the coffer sunk to the bottom; and if it did not set level, the sluice was shut, and the water pumped out, so as to make it float till such time as the foundation was levelled: then the masons crampt the stones of the first course, and laid a second; which being likewise crampt, a third course was laid: then the sluice being opened again, proper care was taken that the coffer should settle in its due place. The stone-work being thus raised to within two feet of the common low-water mark, about two hours before low-water the sluice was shut, and the water pumped out so far as that the masons could lay the next course of stone, which they continued to do till the water was risen so high as to make it unsafe to proceed any farther: then they left off the work, and opened the sluice to let in the water. Thus they continued to work night and day at low-water, till they had carried their work some feet higher than the low-water mark: after this, the sides of the coffer were loosened from the bottom, which made them float; and then were carried ashore to be fixed to another bottom, in order to serve for the next pier.

It must be observed, that the coffer being no higher than 16 feet, which is equal to the greatest depth of water, and the foundation being 6 feet under the bed of the river; the coffer was therefore 6 feet under water when the tide was in; but being loaded with three courses of stones, and well secured with ropes fastened to the piles, it could not move from its place. By making it no higher, much labour and expence were saved: yet it answered the intent full as well as if it had been high enough to reach above the highest flood.

The pier being thus carried on above low-water mark, the masons finished the rest of it during the intervals of the tides in the usual way; and after all the piers and abutments were finished in a like manner, the arches were begun and completed as mentioned before: the whole bridge was built in about seven years, without any accidents happening either in the work or to the workmen, which is seldom the case in works of this nature.

134 Materials employed.

It may be observed, that all the piers were built with solid Portland stone, some of which weighed four tons. The arch-stones were likewise of the same sort: but the rest of the masonry was finished with Kentish *rag-stones*; and the paths for foot passengers were paved with *purbec*, which is the hardest stone to be had in England, excepting Plymouth marble.

135 This method sometimes impracticable.

This method of building bridges is certainly the easiest and cheapest that can be thought of, but cannot be used in many cases: when the foundation is so bad as not to be depended upon without being piled, or the depth of water is very great, with a stong current and no tide, it cannot then be practised. For if piles are to be used, it will be next to impossible to cut them off in the same level five or six feet below the bed of the river, notwithstanding that saws have been invented for that purpose: because if they are cut off separately, it will be a hard matter to do it so nicely that the one shall not exceed the other in height; and if this is not done, the grating or bottom of the coffer will not be equally sup-

Practice. supported, whereby the foundation becomes precarious: neither can they be cut off all together; for piles are to be driven as far as the bottom of the coffer extends, which at Westminster bridge was 27 feet; the saw must have 3 feet play, which makes the total length of the saw 30 feet; now if either the water is deeper than it is there, or the arches are wider, the saw must still be longer; so that this method is impracticable in any such cases.

In a great depth of water that has a strong current and no tide, the coffers must reach above the water, which makes them very expensive, and unwieldy to manage, as well as very difficult to be secured in their places, and kept steady: so that there is no probability of using them in such a case.

136 Russian method. In some cases, when there is a great depth of water, and the bed of the river is tolerably level, or where it can be made so by any contrivance, a very strong frame of timber about four times as large as the base of the piers may be let down with stones upon it round the edges to make it sink: after fixing it level, piles must be driven about it to keep it in its place; and then the foundation may be laid in coffers as before, which are to be kept steady by means of ropes tied to the piles.

This method has frequently been used in Russia; and though the bed of the river is not very solid, yet such a grate, when once well settled with the weight of the pier upon it, will be as firm as if piles had been driven under the foundation; but to prevent the water from gulling under the foundation, and to secure it against all accidents, a row of dove-tail piles must be driven quite round the grating: this precaution being taken, the foundation will be as secure as any that can be made.

137 French method. The French engineers make use of another method in raising the foundations of masonry under water; which is, to drive a row of piles round the intended place, nearer to, or farther from, each other, according as the water is more deep or shallow: these piles, being strongly bound together in several places with horizontal tie-beams, serve to support a row of dove-tail piles driven within them: when this is done, and all well secured according to the nature of the situation and circumstances, they dig the foundation by means of a machine with scoops, invented for that purpose, until they come to a solid bed of gravel or clay; or if the bed of the river is of a soft consistence to a great depth, it is dug only to about six feet, and a grate of timber is laid upon it, which is well secured with piles driven into the opposite corners of each square, not minding whether they exceed the upper surface of the grate much or little.

When the foundation is thus prepared, they make a kind of mortar called *beton*, which consists of twelve parts of pozolano or Dutch terrass, six of good sand, nine of unslacked lime, the best that can be had, thirteen of stone splinters not exceeding the bigness of an egg, and three parts of tile-dust, or cinders, or else scales of iron out of a forge: this being well worked together must be left standing for about 24 hours, or till it becomes so hard as not to be separated without a pick-ax.

This mortar being thus prepared, they throw into the coffer a bed of ruble-stone, not very large, and spread them all over the bottom as nearly level as they can; then they sink a box full of this hard mortar, broken into pieces, till it comes within a little of the bottom; the box is so contrived as to be overset or turned upside down at any depth; which being done, the pieces of mortar soften, and so fill up the vacant spaces between the stones; by these means they sink as much of it as will form a bed of about 12 inches deep all over; then they throw in another bed of stone, and continue alternately to throw one of mortar and one of stone till the work approaches near the surface of the water where it is levelled, and then the rest is finished with stones in the usual manner. Practice.

Mr Belidor says, in the second part of his Hydraulics, vol. ii. p. 188, that Mr Millet de Montville having filled a coffer containing 27 cubit feet, with masonry made of this mortar, and sunk it into the sea, it was there left standing for two months, and when it was taken out again it was harder than stone itself. 138 Impossibility of building bridges in some cases.

We have hitherto mentioned such situations only where the ground is of a soft nature: but where it is rocky and uneven, all the former methods prove ineffectual; nor indeed has their yet been any one proposed which can be always used upon such occasions, especially in a great depth of water. When the water is not so deep but that the unevenness of the rock can be perceived by the eye, piles strongly shod with iron may be raised and let fall down, by means of a machine, upon the higher parts, so as to break them off piece by piece, till the foundation is tolerably even, especially when the rock is not very hard; which being done, either this or any other way that can be thought of, a coffer is made without any bottom, which is let down and well secured, so as not to move from its place: to make it sink, heavy stones should be fixed on the outside; then strong mortar and stones must be thrown into it; and if the foundation is once brought to a level, large hewn stones may be let down so as to lie flat and even: by these means the work may be carried on quite up to the surface of the water. But when the water is so deep, or the rock so hard as not to be levelled, the foundation must be sounded, so as to get nearly the risings and fallings; then the lower part of the coffer must be cut nearly in the same manner, and the rest finished as before. It must however be observed, that we suppose a possibility of sinking a coffer; but where this cannot be done, no method that we know of will answer.

Among the aquatic buildings of the ancients none appears to have been more magnificent than Trajan's bridge. Dion Cassius gives the following account of it: "Trajan built a bridge over the Danube, which in truth one cannot sufficiently admire; for though all the works of Trajan are very magnificent, yet this far exceeds all the others: the piers were 20 in number, of square stones; each of them 150 feet high above the foundation, 60 feet in breadth, and distant from one another 170 feet. Though the expence of this work must have been exceeding great, yet it becomes more extraordinary by the rivers being very rapid, and its bottom of a soft nature: where the bridge was built, was the narrowest part of the river thereabout, for in most others it is double or treble this breadth; and although on this account it became so much the deeper and the more rigid, yet no other place was so suitable for this undertaking. The arches were afterwards 139 Trajan's bridge over the Danube described.

broken

broken down by Adrian; but the piers are ſtill remaining, which ſeem as it were to teſtify that there is nothing which human ingenuity is not able to effect." The whole length then of this bridge was 1590 yards; ſome authors add, that it was built in one ſummer, and that Apollodorus of Damaſcus was the architect, who left behind him a deſcription of this great work.

140 Wooden bridges.

Where ſtone bridges cannot be erected on account of the expence, very ſtrong and durable ones may be conſtructed of wood: in which caſe they ought to be ſo framed, as that all the parts may preſs upon one another like the arch of a ſtone bridge; and thus, inſtead of being weakened by great weights paſſing over them, they will become the ſtronger. How this is to be accompliſhed, will be better underſtood from the figure at bottom of Plate LIII. which repreſents a wooden bridge conſtructed after this manner, than it can be by any deſcription.

2. Of Harbours.

141 Situation proper for harbours.

In theſe, the firſt thing to be conſidered is the ſituation; which may be ſome large creek or baſon of water, in or near the place where the harbour is intended to be made, or at the entrance of a large river, or near the ſea: for a harbour ſhould never be dug entirely out of dry land, unleſs upon ſome extraordinary occaſions, where it is impoſſible to do otherwiſe, and yet a harbour is abſolutely neceſſary. When a proper place is found, before it is fixed upon, it muſt be conſidered whether ſhips can lie there ſafe in ſtormy weather, eſpecially when thoſe winds blow which are moſt dangerous upon that coaſt; whether there be any hills, riſing ground, or high buildings, that will cover it; in theſe caſes, the ſituation is very proper: but if there be nothing already that will cover the ſhips, it muſt be obſerved whether any covering can be made at a moderate expence, otherwiſe it would be uſeleſs to build a harbour there.

The next thing to be conſidered is, whether there be a ſufficient depth of water for large ſhips to enter with ſafety, and lie there without touching the ground; and if not, whether the entrance and inſide might not be made deeper at a moderate expence: or, in caſe a ſufficient depth of water is not to be had for large ſhips, whether the harbour would not be uſeful for ſmall merchantmen; for ſuch a one is often of great advantage, when ſituated upon a coaſt much frequented by ſmall coaſting veſſels.

The form of the harbour muſt be determined in ſuch a manner, that the ſhips which come in when it is ſtormy weather may lie ſafe, and ſo as there may be ſufficient room for as many as paſs that way: the depths of water where the piers are to be built muſt be taken at every 10, 15, or 20, feet diſtance, and marked upon piles driven here and there, in order that the workmen may be directed in laying the foundation.

142 Materials.

This being done, it muſt be conſidered what kind of materials are to be uſed, whether ſtone, brick, or wood. When ſtones are to be had at a moderate price, they ought to be preferred, becauſe the work will be much ſtronger, more laſting, and need fewer repairs, than if made with any other materials: but when ſtones are ſcarce, and the expence becomes greater than what is allowed for building the harbour, the foundation may be made of ſtone as high as low-water mark, and the reſt finiſhed with brick. If this manner of building ſhould ſtill be too expenſive, wood muſt be uſed; that is, piles are driven as cloſe as is thought neceſſary; which being faſtened together by croſs-bars, and covered with ſtrong oaken planks, form a kind of coffer, which is filled with all kinds of ſtones, chalk, and ſhingles.

143 French method of building.

The manner of laying the foundation in different depths of water, and in various ſoils, requires particular methods to be followed. When the water is very deep, the French throw in a great quantity of ſtones at random, ſo as to form a much larger baſe than would be required upon dry land; this they continue to within 3 or 4 feet of the ſurface of the water, where they lay the ſtones in a regular manner, till the foundation is raiſed above the water: they then lay a great weight of ſtones upon it, and let it ſtand during the winter, to ſettle; as likewiſe to ſee whether it is firm, and reſiſts the force of the waves and winds: after that, they finiſh the ſuperſtructure with large ſtones in the uſual manner.

144 A preferable one.

As this method requires a great quantity of ſtones, it can be practiſed only in places where ſtones are in plenty; and therefore the following one is much preferable. A coffer is made with dove-tail piles of above 30 yards long, and as wide as the thickneſs of the foundation is to be; then the ground is dug and levelled, and the wall is built with the beſt mortar.

As ſoon as the mortar is tolerably dry, thoſe piles at the end of the wall are drawn out, the ſide-rows are continued to about 30 yards farther, and the end incloſed; then the foundation is cleared, and the ſtones laid as before. But it muſt be obſerved, that the end of the foundation finiſhed is left rough, in order that the part next to it may incorporate with it in a proper manner: but if it is not very dry, it will incline that way of itſelf, and bind with the mortar that is thrown in next to it: this method is continued till the whole pier is entirely finiſhed.

It muſt likewiſe be obſerved, that the piers are not made of one continued ſolid wall; becauſe in deep water it would be too expenſive: for which reaſon, two walls are built parallel to each other, and the interval between them is filled up with ſhingles, chalk, and ſtone. As theſe walls are in danger of being thruſt out or overſet, by the corps in the middle, together with the great weight laid at times on the peir, they are tied or bound together by croſs-walls at every 30 or 40 yards diſtance, by which they ſupport each other in a firm and ſtrong manner.

In a country where there is a great plenty of ſtones, piles may be driven in as deep as they will go, at about two or three feet diſtance; and when the foundation is ſunk and levelled, large ſtones may be let down, which will bed themſelves: but care muſt be taken to lay them cloſe, and ſo as to have no two joints over each other; and when the wall is come within reach, the ſtones muſt be crampt together.

145 Another method with coffers

Another method practiſed, is to build in coffers much after the ſame manner as has been done in building the piers of Weſtminſter bridge; but as in this caſe the ends of the coffers are left in the wall, and prevent their joining ſo well as to be water-tight, the water that penetrates through and enters into the corps may occa-

ſion

Practice.

sion the wall to burst and to tumble down. Another inconveniency arising from this manner of building is, that as there are but few places without worms, which will destroy wood where-ever they cand find it; by their means the water is let into the pier, and consequently makes the work liable to the same accident as has been mentioned above.

149 Russian method.

To prevent these inconveniences, the best method is, to take the wood away, and joggle the ends of the walls together with large stones, pouring terrass-mortar into the joints; when this is done, the water between the two walls may be pumpt out, and the void space filled up with stone and shingle as usual: or if these joggles cannot be made water-tight, some dove-tail piles must be driven at each end as close to the wall as can be done, and strong sail-cloth put on the outside of them, which, when the water is pumpt out, will stick so close to the piles and wall, that no water can come in. This method is commonly used in Russia.

147 Thickness of piers.

The thickness of a pier depends on two considerations: it ought to be both such as may be able to resist the shock of the waves in stormy weather; and also to be of a sufficient breadth above, that ships may be laden or unladen whenever it is thought necessary. Now, because the specific gravity of sea-water is about one half that of brick, and as 2 to 5 in comparison of stone; and since the pressure of stagnated water against any surface is equal to the weight of the prism of water whose altitude is the length of that surface, and whose base is a right angled isosceles triangle, each of the equal sides being equal to the depth of the water; therefore a pier built with bricks, whose thickness is equal to the depth of the water, will weigh about four times as much as the pressure of the water against it; and one of stone of the same breadth, about six times and a quarter as much. Now this is not the force to be considered, since this pressure is the same within as without the pier: but it is that force with which the waves strike against the piers, and that depends on the weight and velocity of the waves, which can hardly be determined; because they vary according to the different depths of water, the distance from the shore, and according to the tides, winds, and other causes. Consequently the proper thickness of the piers cannot be determined by any other means than by experience.

Practitioners suppose, that if the thickness of a pier is equal to the depth of the water, it is sufficient; but for a greater security they allow 2, 3, or 4 feet more. This might probably do, if piers were built with solid stones crampt together; but as this is hardly ever the case, and on the contrary, as the inside is filled up with shingle, chalk, or other loose materials, their rule is not to be depended upon: besides it makes the space above too narrow for lading and unlading the ships, unless in a great depth of water; so that it does not appear that the method can be followed, excepting in a very few cases where the water has but very little motion.

When stone can be had, no other materials should be used, because they being of a larger bulk than brick, will better resist the waves by their own weight, till such time as the mortar is grown hard; for after this is effected, brick will resist better against the action of sea-water than soft stones.

The wall must be built with terrass mortar from the bottom to the height of low-water mark, and the rest finished with cinder or tile-dust mortar, which has been found sufficiently good in those places where the wall is wet and dry alternately. The upper part of the pier should be paved with flat hewn stones laid in strong mortar, in order to prevent any water from penetrating into it: iron rings ought also to be fixed here and there at proper distances, to fasten the ships, and prevent them from striking against the pier when agitated by the waves.

Wooden fenders or piles should be driven at the inside close to the wall, and crampt to it with iron, to prevent the ships from touching them, and from being worn by the continual motion. Where the sea breaks against the piers with great violence, breakers should be made at proper distances; that is, two rows of piles are driven nearly at right angles to the piers for the length of about 12 or 15 feet, and at about 8 or 10 feet distant from each other; and then another to join the two former: these piles being covered with planks, and the inside being filled with shingle and ruble-stones, then the top is paved with stones of about a foot in length, set long-wise to prevent the waves from tearing them up. This precaution is absolutely necessary where the water rushes in very strongly.

Military ARCHITECTURE, the same with what is otherwise called *fortification*. See FORTIFICATION.

Naval ARCHITECTURE, the art of building ships. See SHIP-*Building*.

ARCHITRAVE, in architecture, that part of a column which lies immediately upon the capital, being the lowest member of the entablature. See Plate XXXVII.

Over a chimney, this member is called the *mantle-piece*; and over doors or windows, the *hyperthyron*.

ARCHITRICLINUS, in antiquity, the master or director of a feast, charged with the order and œconomy of it, the covering and uncovering of the tables, the command of the servants, and the like.

The architriclinus was sometimes called *servus tricliniarcha*, and by the Greeks προγευστης, i. e. *prægustator*, or *fore-taster*. Potter also takes the architriclinus for the same with the symposiarcha.

ARCHIVAULT, in architecture, implies the inner contour of an arch, or a band adorned with mouldings, running over the faces of the arch-stones, and bearing upon the imposts. It has only a single face in the Tuscan order, two faces crowned in the Doric and Ionic, and the same mouldings as the architrave in the Corinthian and Composite.

ARCHIVE, or ARCHIVES, a chamber or apartment wherein the records, charters, and other papers and evidences, of a state, house, or community, are preserved, to be consulted occasionally.

We say, the *archives* of a college, of a monastery, &c.

&c. The archives of ancient Rome were in the temple of Saturn; the archives of the court of chancery are in the rolls office.

ARCHIVIST, Archivista, a keeper of an archive.

Under the emperors, the archivist was an officer of great dignity, held equal to the proconsuls, vested with the quality of a count, styled *clarissimus*, and exempted from all public offices and taxes. Among the ancient Greeks and Persians, the trust was committed to none but men of the first rank; among the Franks, the clergy being the only men of letters, kept the office among themselves.—Since the erection of the electoral college, the Archbishop of Mentz has had the direction of the archives of the empire.

ARCHMARSHAL, the grand marshal of the empire, a dignity belonging to the elector of Saxony.

ARCHONS, in Grecian antiquity, were magistrates appointed after the death of Codrus*. They were chosen from the most illustrious families till the time of Aristides, who got a law passed, by which it was enacted, that, in electing these magistrates, less regard should be paid to birth than to merit.

* See the article *Attica*

The tribunal of the archons was composed of nine officers. The first was properly the *archon;* by whose name the year of his administration was distinguished. The title of the second was *king;* that of the third, *polemarchus:* to these were added six *thesmothetæ*. These magistrates, elected by the scrutiny of beans, were obliged to prove, before their respective tribes, that they had sprung, both in their father's and their mother's side, for three descents, from citizens of Athens. They were likewise to prove that they were attached to the worship of Apollo, the tutelary god of their country; that they had in their house an altar consecrated to Apollo; and that they had been respectfully obedient to their parents; an important and sacred part of their character, which promised that they would be faithful servants to their country. They were likewise to prove, that they had served in a military capacity the number of years which the republic required of every citizen: and this qualification gave the state experienced officers; for they were not allowed to quit the army till they were 40 years old. Their fortune too, of which they were to inform those before whom they were examined, was a warrant for their fidelity.

After the commissioners, who were appointed to inquire into their character and other requisites, had made a report of them, they were then to swear that they would maintain the laws; which obligation if they neglected, they engaged to send to Delphi a statue of the weight of their bodies. According to a law of Solon, if an archon got drunk, he was condemned to pay a heavy fine, and sometimes even punished with death. Such magistrates as the Athenian archons were well intitled to respect. Hence it was eternal infamy to insult them; and hence Demosthenes observed, that to treat the thesmothetæ with disrespect, was to show disrespect to the republic.

Another qualification indispensibly required of the second officer of this tribunal, who was called the *king*, was, that he had married the daughter of an Athenian citizen, and that he had espoused her a virgin. This was exacted of him, says Demosthenes, because part of his duty was to sacrifice to the gods jointly with his wife, who, instead of appeasing, would have irritated them, if she had not possessed both those honours.

The inquiry into the private title of the nine archons was very severe; and this attention was the more necessary, as they had a right to take a seat in the Areopagus, after they had quitted their office, and given an account of their administration.

When any obscurity occurred in the laws relative to religion and the worship of the gods, the interpretation was submitted to the tribunal of the archons.

Aristotle observes, that Solon, whose aim was to make his people happy, and who found their government in his time aristocratical, by the election of the nine archons, who were annual magistrates, tempered their power, by establishing the privilege of appealing from them to the people, called by lot to give their suffrage, after having taken the oath of the Heliastæ, in a place near the Panathenæum, where Hissus had formerly calmed a sedition of the people, and bound them to peace by an oath.

The archons were the principal officers, not only in civil, but likewise in sacred matters, and especially in the mysteries of Bacchus. The archons, however, who were surnamed *eponymi*, were chiefly employed in civil affairs; yet they presided at the great feasts, and held the first rank there. Hence they are sometimes styled *priests*.

Archon is also applied by some authors to divers officers, both civil and religious, under the eastern or Greek empire. Thus bishops are sometimes called *archontes;* and the same may be said of the lords of the emperor's court. We also read of the *archon of the antimensia, archon of archons, grand archon, archon of churches, archon of the gospel, archon of the walls, &c.*

ARCHONTICI, in church-history, a branch of Valentinians, who maintained that the world was not created by God, but by angels called *Archontes*.

ARCHPRIEST, Archpresbyter, a priest or presbyter established in some dioceses, with a pre-eminence over the rest. Anciently the archpriest was the first person after the bishop: he was seated in the church next after the bishop; and even acted as his vicar, in his absence, as to all spiritual concerns. In the sixth century, there were found several archpriests in the same diocese; from which time some will have them to have been called *deans*. In the ninth century, they distinguished two kinds of cures or parishes: the smaller governed by simple priests; and the baptismal churches by archpriests; who, beside the immediate concern of the cure, had the inspection of the other inferior priests, and gave an account of them to the bishop, who governed the chief, or cathedral church, in person. There are archpresbyters still subsisting in the Greek church; vested with most of the functions and privileges of the chorepiscopi or rural deans.

ARCHTREASURER, the great treasurer of the German empire. This office was created with the eighth electorate, in favour of the elector Palatine, who had lost his former electorate, which was given to the duke of Bavaria, by the emperor Ferdinand II. who took it away from Frederic V. elector Palatine, after the battle of Prague, where he was defeated in maintaining his election to the crown of Bohemia. The dignity of archtreasurer was contested be-

tween

tween the elector of Brunſwick, who claimed it in virtue of his deſcent from the elector of Frederic and the elector Palatine.

ARCHILUTE, Arcileuto, a long and large lute, having its baſs ſtrings lengthened after the manner of the theorbo, and each row doubled, either with a little octave or an uniſon. It is uſed by the Italians for playing a thorough baſs.

ARCHYTAS of Tarentum, a philoſopher of the Pythagorean ſect, and famous for being the maſter of Plato, Eudoxas, and Philolaus, lived about 408 years before Chriſt. He was an excellent mathematician, particularly in that part of the ſcience which regards mechanics: he is ſaid to have made a wooden pigeon that could fly, and to be the firſt that brought down mathematics to common uſes. He is ſaid to be the inventor of the ten categories. He aſſerted, that God was the beginning, the ſupporter, and the end, of all things. There are two epiſtles preſerved in Diogenes Laertius, one from Archytas to Plato, and another from Plato to Archytas. He acquired great reputation in his legiſlative capacity. He likewiſe commanded the army ſeven times, and was never defeated; but was at laſt caſt away in the Adriatic Sea, and thrown upon the coaſt of Apulia.

ARCIS-SUR-AUBE, a ſmall handſome town of France, in Champaigne, ſeated on the river Aube. E. Long. 4. 15. N. Lat. 48. 40.

ARCO, a ſtrong town and caſtle in the Trentin, belonging to the houſe of Auſtria. It was taken by the French in 1703, and abandoned ſoon after. It ſtands on the river Sarca, near the north extremity of the lake Garda. E. Long. 9. 55. N. Lat. 45. 52.

ARCONA, a ſtrong town ſituated on the iſland of Rugen in the Baltic. It ſtood on a high promontory, with the eaſt, north, and ſouth ſides defended by ſteep and lofty precipices, and the weſt by a wall fifty feet high, proportionably thick, and ſecured by a deep and broad ditch. It was, however, taken and ruined, in 1168, by Valdemar king of Denmark. One of the conditions impoſed by the conqueror was, that the inhabitants ſhould deſtroy a temple they had erected to St Vitus, and deliver up the vaſt treaſure belonging to this tutelary ſaint. Another was, that they ſhould pay 40 ſilver yokes for oxen, by way of tribute, and enter as ſoldiers in the Daniſh ſervice when called upon.

ARCOS, a ſtrong city of Andaluſia, in Spain, ſeated on a high craggy rock, at the bottom of which runs the Gaudeleto. Its ſtrength lies not only in its ſituation, but in the works erected for its defence, and it is inacceſſible on every ſide but one. The governor reſides in an old caſtle, from whence there is a delightful proſpect, which extends very far into the neighbouring country. W. Long. 2. 10. N. Lat. 36. 40.

ARCTIC, in aſtronomy, an epithet given to the north pole, or the pole raiſed above our horizon. It is called the *arctic pole*, on occaſion of the conſtellation of the little bear, in Greek called αρκτος; the laſt ſtar in the tail whereof nearly points out the north pole.

Arctic Circle is a leſſer circle of the ſphere, parallel to the equator, and 23° 30′ diſtant from the north pole; from whence its name. This, and its oppoſite, the *antarctic*, are called the two *polar circles*; and may be conceived to be deſcribed by the motion of the poles of the ecliptic, round the poles of the equator, or of the world.

ARCTIUM, Burdock: A genus of the polygamia æqualis order, belonging to the ſyngeneſia claſs of plants; and in the natural method ranking under the 49th order, *Compoſitæ-capitatæ:* The calyx is globular; with ſcales having hooks reflected at the tops.—The ſpecies are three, viz. the lappa or common burdock, the tomentoſum, and the perſonata. All theſe are troubleſome weeds, ſo require no direction for their culture. The tender ſtems of the common kind, deprived of the bark, may be boiled and eat like aſparagus. When raw, they are good with oil and vinegar. Boys catch bats by throwing the prickly heads of this ſpecies up into the air. Cows and goats eat this herb; ſheep and horſes refuſe it; ſwine are not fond of it. The ſeeds, which have a bitteriſh ſubacrid taſte, are recommended as very efficacious diuretics, given either in the form of emulſion, or in powder to the quantity of a dram. The roots, which taſte ſweetiſh, with a ſlight auſterity and bitteriſhneſs, are eſteemed aperient, diuretic, and ſudorific; and ſaid to act without irritation, ſo as to be ſafely ventured upon in acute diſorders.

ARCTOPHYLAX, (from αρκτος, *bear*, and φυλαττω, *I guard*,) in aſtronomy, a conſtellation, otherwiſe called *Bootes*.

ARCTOPUS, in botany: A genus of the polygamia diœcia claſs; and in the natural method ranking under the 45th order, *Umbellatæ*. The umbella of the male is compound; the involucrum conſiſts of five leaves; the corolla has five petals; the ſtamina are five; and two piſtilli: The umbella of the hermaphrodite is ſimple; the involucrum is divided into four parts, is ſpinous, large, and contains many male flowers in the diſk. There is but one ſpecies of arctopus, viz. the echinatus, a native of Ethiopia.

ARCTOTIS, in botany: A genus of the polygamia neceſſaria order, belonging to the ſyngeneſia claſs of plants; and in the natural method ranking under the 49th order, *Compoſitæ-diſcoides*. The receptacle is briſtly; the corona of the pappus is pentaphyllous; and the calyx is imbricated with ſcales looſe at the top. It is commonly called *anemoſpermos*, from the reſemblance of its ſeeds to thoſe of the anemone. The ſpecies are 11; all of them natives of Ethiopia, or the Cape of Good Hope. Of theſe the anguſtifolia with ſpear-ſhaped leaves, and the aſpera with wing-ſhaped woolly leaves, are moſt remarkable for their beauty, having rays of a fine yellow or deep gold colour. They flower in May and June.

Culture. All the ſpecies of arctotis, may be propagated by cuttings; which ſhould be frequently renewed, as the old plants are ſubject to decay in winter. They may be planted in any of the ſummer months, in a bed of light freſh earth; obſerving to ſhade them from the ſun until they have taken root. They ſhould be expoſed to the open air until the latter end of October, or longer, if the weather is favourable, when they muſt be removed into the green-houſe.

ARCTURUS, in aſtronomy, a fixed ſtar, of the firſt magnitude, in the conſtellation of Arctophylax, or Bootes. The word is formed of αρκτος, *bear*, and ουρα, *tail*; q. d. *bear's tail*, as being very near it. This

Plate LV

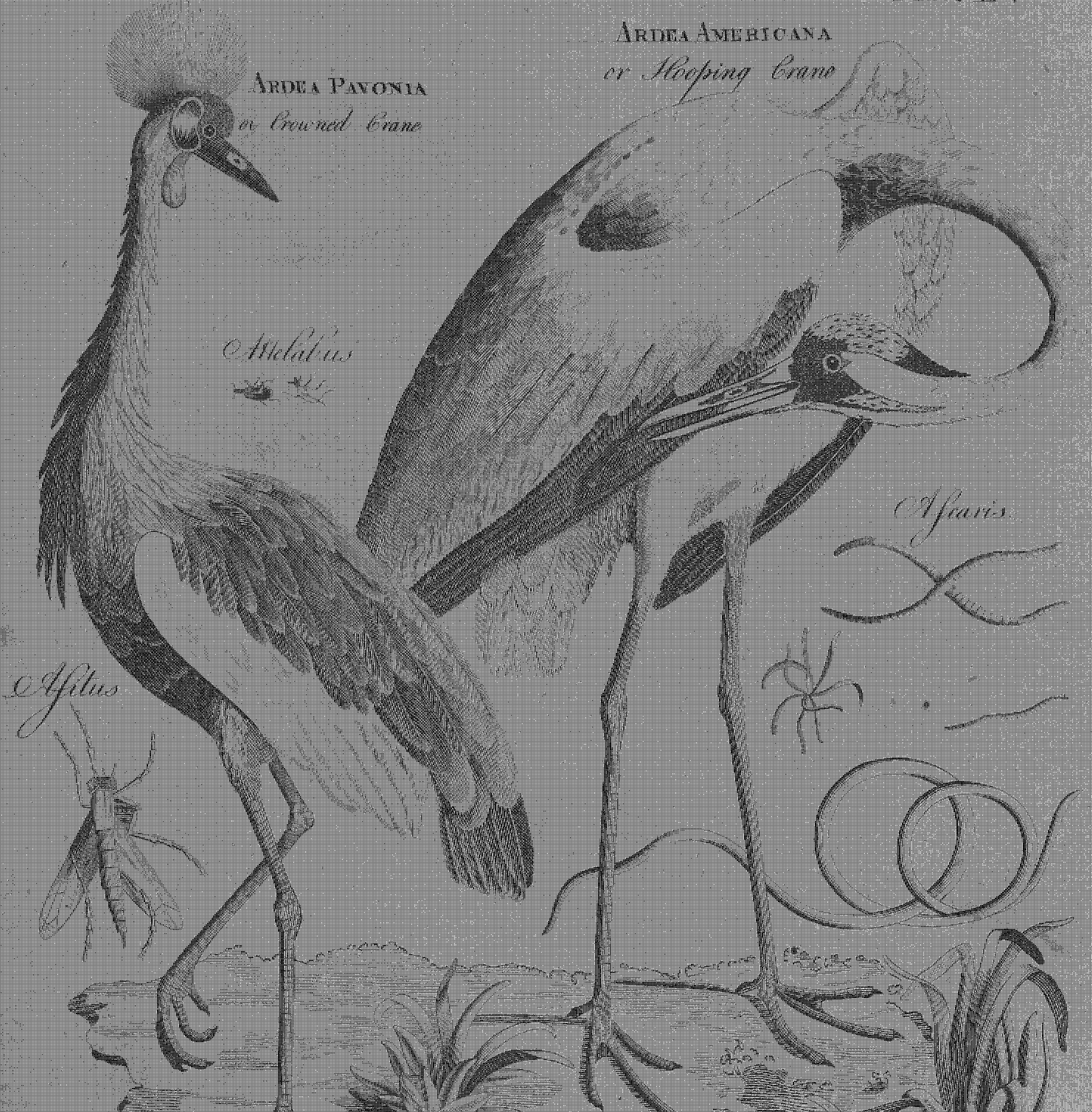

ARDEA AMERICANA
or Hooping Crane
ARDEA PAVONIA
or Crowned Crane
Attelabus
Ascaris
Asilus
Scot Philad.a sc

Plate LVI.

Thackara & Vallance, Sculp.

ſtar was known to the ancients, as in the following verſe of Virgil:

Arcturum, Pluviaſque Hyades, geminoſque Triones.

See Alſo Job ix. 9. xxxviii. 32.

ARCUATION, in gardening, the method of raiſing trees by layers, which is done in the following manner:

Strong mother-plants or ſtools muſt be planted in a clear border, and in a ſtraight line, about ſix feet aſunder. When theſe have ſhot five or ſix main branches from the root, and as many collateral branches, the former muſt be bent to the ground, and there faſtened. The ſmall branches muſt be covered three inches deep upon the joints, and have a large baſon of earth made round them to hold the water.

About the middle of September they may be opened, and, if they have taken root, may be immediately removed into the nurſery; but if they have not ſufficiently extended their roots, they muſt be ſuffered to remain till the ſpring, and then tranſplanted.

ARCUCCIO, Arcutio, a machine made of a board, covered with pieces of hoops, like the tilt of a waggon; uſed in Italy to prevent children from being overlaid and ſmothered by nurſes or others. Every nurſe in Florence is obliged to lay her child in an arcutio, under pain of excommunication.

ARDAMON, or Ardama, in antiquity, a veſſel of water placed at the door of a perſon deceaſed, till the time of burial, as a token that the family was in mourning, and to ſerve to ſprinkle and purify perſons as they came out of the houſe.

ARDASSES, in commerce, the coarſeſt of all the ſilks of Perſia; and as it were the refuſe of each kind. In this ſenſe they ſay, the *legis*, the *houſets*, the *chouſs*, and the *payas ardaſſes*, to ſignify the worſt of thoſe four ſorts of Perſian ſilks.

ARDASSINES, in commerce, called in France *ablaques*; a very fine ſort of Perſian ſilks, little inferior in fineneſs to the ſourbaſtis, or rather cherbaſſis, and yet it is little uſed in the ſilk manufactures of Lyons and Tours, becauſe that kind of ſilk will not bear hot water in the winding.

ARDEA, in ornithology, a genus of the order of grallæ. The general characters of this order are theſe: The bill is ſtraight, ſharp, long, and ſomewhat compreſſed, with a furrow that runs from the noſtrils towards the point; the noſtrils are linear; and the feet have four toes. Under this genus Linnæus comprehends the grus or crane, the ciconia or ſtork, and the ardea or heron, of other authors. See Plates LV. LVI.

1. The firſt ſpecies is the pavonia, or crowned crane, which has an erect briſtly creſt, with the temples and two wattles naked. The head is black; the creſt is yellowiſh, and tipped with black at the top; the wings are white; and the feathers of the tail black, and of an equal length. It is a native of Africa, particularly the coaſt of Guinea, as far as Cape Verd; at this laſt place they are ſaid to be exceedingly tame, and will often come into the court-yards to feed with the poultry. Theſe birds are often kept in our menageries, and, with ſhelter of nights, live a good while. Their chief food is ſuppoſed to be worms, and ſuch other things as the heron tribe uſually feed on; alſo vegetables of all kinds. It often ſleeps on one leg; runs very faſt; and is ſaid not only to fly well, but to continue on the wing for a long time together. The fleſh is ſaid to be very tough.

2. The Virgo, with a ſtraight greeniſh bill and crimſon irides. The crown of the head is aſh-colour; the reſt of the head, the upper part of the neck behind, and all the under parts to the breaſt, black; the back, rump, and tail, and all the under part from the breaſt, are of a bluiſh aſh-colour: behind each eye ſprings a tuft of long white feathers, which decline downwards, and hang in an elegant manner: the quills and tail are black at the ends; the legs black. This ſpecies is found in many parts of Africa and Aſia, where they frequent marſhes and the neighbourhood of rivers, as their food is fiſh, like moſt of the heron genus. It is frequently kept in menageries, being endowed with great gentleneſs of manners, added to its being an elegant bird. At various times it puts itſelf into ſtrange and uncouth attitudes, eſpecially thoſe which imitate dancing; and Keyſler mentions one in the Great Duke's gallery at Florence, which had been taught to dance to a certain tune, when played or ſung to it. The name this bird is known by in the Eaſt is *kurki*, or *querky*. Sometimes it will breed in confinement: one is recorded to have lived 24 years at Verſailles, where it had been bred.

3. The leucogeranos of Pallas, or Siberian crane of Pennant, is four and a half feet when ſtanding erect. The bill is a red colour; the irides are white: the plumage as white as ſnow, except the 10 firſt greater quills, with the coverts of them, which are black: the legs are long and red. This ſpecies inhabits the vaſt marſhes and lakes in Siberia, eſpecially thoſe about the Iſchim, and along the rivers Ob and Irtiſh. It makes its neſt among the reeds, ſeldom acceſſible by man, upon riſing green graſſy tufts, made up of herbs and graſs heaped together; and lays two aſh-coloured eggs, ſpotted with brown. They are ſhy birds, and always upon their guard againſt an enemy; having a centinel to warn them of an approach; on the leaſt alarm they cry aloud, not unlike the ſwan, and fly off directly. The ſportſman finds, in courſe, much difficulty in approaching them within gunſhot; for, as they ſtand near five feet high from the ground, they are enabled to eſpy him at a greater diſtance. Sometimes indeed he approaches them under cover of a ſtalking-horſe, or other object; at other times a ſmall dog will divert their attention, as they will without fear attack the dog, while his maſter gets within reach. In breeding time, however, they are more bold, as they will defend their young even againſt men, ſo as to make it dangerous to come near their haunts. The male and female are ſaid to guard their neſt by turns.

4. The grus, or common crane of Engliſh authors, has a naked papillous crown; the prime feathers of the wings are black; the body is aſh-coloured; the prime feathers of the tail are ragged. This ſpecies is far ſpread, being met with in great flocks throughout Northern Europe and Aſia; in Sweden, Ruſſia throughout, and Siberia as far as the river Anadyr, migrating even to the arctic circle. In Kamtſchatka they are only ſeen on the ſouthern promontory: are migratory, returning

Ardea. northward to breed in the spring, and generally choosing the same places which had been occupied by them the season before. In the winter they inhabit the warmer regions, such as Egypt, Aleppo, India, &c.: they are also met with at the Cape of Good Hope, changing place with the season. In their migrations they frequently fly so high as not to be visible; their passing only being known by the noise they make, which is louder than any other bird. In France they are seen in spring and autumn; but for the most part are mere passengers.—This species seems to have been formerly a native of Britain; as we find in Willoughby, page 52. that there was a penalty of twenty pence for destroying an egg of this bird; and Mr. Ray informs us, that in his time they were found during the winter in large flocks in Lincolnshire and Cambridgeshire: but at present the inhabitants of those counties are scarcely acquainted with them; so that these birds seem now to have forsaken that island. We are told that they make their nest in the marshes, and lay two bluish eggs. The young birds are thought very good food. They feed on reptiles of all kinds, and in turn on green corn; of which last they are said to make so great havock, as to ruin the farmers where-ever the flocks of these depredators alight.

5. The Americana, or hooping crane of Edwards, is a native of America: The crown of the head and temples are naked and papillous; the forehead, nape of the neck, and prime wing-feathers, are black; but the body is white: The under part of the head, as far as the lower chap, is red; the beak is yellowish, and jagged at the point; the feet are red, and the prime tail-feathers white. This is an American species, often seen at the mouths of the Savanna, Alatamaha, and other rivers near St. Augustine: in spring going to the north to breed, like the common crane, and returning like that bird, to the south in autumn. In the summer they are found in Hudson's Bay, at which place they arrive in May, and retire in September; and are chiefly met with in unfrequented places, in the neighbourhood of lakes, where they breed. The nest is made on the ground, composed of grass and feathers. They lay two white eggs, like those of the swan, and sit 20 days; the young are at first yellow, changing to white by degrees. These birds have a loud long note, which may be heard at a great distance: their food is chiefly worms and insects, which it searches for at the bottom of ponds. The natives of Hudson's Bay call this species *Wapaw-uchechauk*.

6. The argil, or hurgil, of Ives, is a very large species; from tip to tip of the wings measuring 14 feet 10 inches; and from the tip of the bill to the claws seven feet and a half: the bill is 16 inches round at the base, of different colours, and nearly of a triangular shape; the feathers of the back and wings are very strong, and of an iron colour; those of the breast long: over the belly a great deal of down, of a dirty white: the legs and half the thighs are naked; the naked parts full three feet in length.

This monster, as Ives terms it, inhabits Bengal, and is also found at Calcutta; at the last place called *Hurgill*, or *Argill*. It majestically stalks along before one, and appears at first like a naked Indian. The common opinion is, that the souls of the Bramins possess these birds. On opening one of these, a terapin, or land tortoise, 10 inches long, was found in its craw, and a large male black cat was found entire in its stomach. In Sumatra there is said to be a great variety of the stork kind; some of a prodigious size, and otherwise curious; as the Boorong Cambing, and Booringoolar. Ardea.

The same species seems to have been remarked by Mr Smeathman in Africa, while resident there; an adult of one of which will often measure seven feet when standing erect. He describes the plumage much the same as in Mr Ive's bird; adding, that the gape is monstrously wide; the head is covered with white down, thinly dispersed, appearing not unlike a grey-headed man: on the middle of the neck before, a long conic membrane, like a bladder, sprinkled very thinly with short down, rising or falling as the animal moves the beak, and always appearing inflated. These birds are met with in companies. When seen at a distance, near the mouths of rivers, coming towards an observer, which they do with the wings extended, they may well be taken for canoes, upon the surface of a smooth sea: when on the sand-banks, for men and women picking up shell-fish or other things on the beach.

* *Latham's Synopsis*, vol. iii. part I.

One of these, a young bird, about five feet in height, was brought up tame, and presented to the chief of the Bananas, where Mr Smeathman lived; and being accustomed to be fed in the great hall, soon became familiar; duly attending that place at dinner-time, and placing itself behind its master's chair, frequently before any of the guests entered. The servants were obliged to watch it narrowly, and to defend the provisions with switches in their hands; but, notwithstanding this, it would frequently snatch off somewhat or other, and was known once to have purloined a whole boiled fowl, which it swallowed in an instant. Its courage is not equal to its voracity; for a child of eight or ten years old soon puts it to flight with a switch, though at first it seems to stand upon its defence, by threatening with its enormous bill widely extended, and crying out with a loud hoarse voice like a bear or tiger. It is an enemy to small quadrupeds, as well as birds and reptiles, and destroys fowls and chickens, though it dare not attack a hen with her young openly: it preys also on rats, young kittens, and the like: and has been known to swallow a cat whole: a bone of a shin of beef being broke asunder, serves it but for two morsels. The individual abovementioned used to fly about the island, and roost very high upon the silk-cotton trees; from whence, at two or three miles distance it could spy the dinner carrying across the yard; when, darting from its station, it would enter promiscuously with the women who carried in the dishes. When sitting, it was observed to rest itself on the whole length of the hind part of the legs. It sometimes stood near, for half an hour after dinner, with the head turning alternately, as if listening to the conversation; and during this time would every three or four minutes void the excrements, which were liquid and whitish; and took care always to do this on its legs, by wheeling the back parts round over one or the other, and this regularly on different legs; for if he had muted on the left leg last, he would be sure to do the same on the right the next time, never making any mistake.

7. The ciconia, or white stork of Ray, has naked eye-balls, and black prime wing-feathers. The skin be-

Ardea. low the feathers, as also the beak, feet, and claws, are of a blood colour. It is a native of Europe, Asia, and Africa; but is seldom or never to be met with in Italy. The ciconia feeds upon amphibious animals. It is such an enemy to serpents, that it is reckoned almost a crime to kill a stork. From this favourable treatment, they are seen in Holland and the Low Countries walking unconcerned in the middle of the streets. Storks are birds of passage; they spend the summer in Europe, and disappear all at once, and go off to Egypt, Ethiopia, &c. before winter, and do not return till about the middle of March.

8. The major, or common heron, has a black crest depending from the back part of the head, an ash-coloured body, and a black line and belt on the neck and breast. It is a native of Europe. This bird is remarkably light in proportion to its bulk, scarce weighing three pounds and an half: the length is three feet two inches; the breadth five feet four inches. The body is very small, and always lean; and the skin scarce thicker than what is called gold-beater's skin. It must be capable of bearing a long abstinence, as its food, which is fish and frogs, cannot be readily got at all times. It commits great devastation in ponds; but being unprovided with webs to swim, nature has furnished it with very long legs to wade after its prey. It perches and builds in trees, and sometimes in high cliffs over the sea, commonly in company with others, like rooks. It makes its nest of sticks, lines it with wool, and lays five or six large eggs of a pale green colour. During incubation, the male passes much of his time perched by the female. They desert their nests during the winter, excepting in February, when they resort to repair them. It was formerly in Britain a bird of game, heron-hawking being so favourite a diversion of the inhabitants, that laws were enacted for the preservation of the species, and the person who destroyed their eggs was liable to a penalty of twenty shillings for each offence. Not to know the hawk from the heron-shaw was an old proverb*, taken originally from this diversion; but in course of time served to express great ignorance in any science. This bird was formerly much esteemed as food; made a favourite dish at great tables, and was valued at the same rate as a pheasant. It is said to be very long-lived: by Mr Keysler's account it may exceed 60 years; and by a recent instance of one that was taken in Holland by a hawk belonging to the Stadtholder, its longevity is again confirmed, the bird having a silver plate fastened to one leg, with an inscription, importing it had been before struck by the elector of Cologne's hawks in 1735.—The cinerea of Linnæus is the female of this species.

* In aftertimes this proverb was absurdly corrupted to, He does not know a *hawk* from a *hand-saw*.

9. The grazetta, or egret, is crested behind; the body is white, the beak black, and the feet greenish. It is a most elegant bird. It weighs about one pound; and the length is 24 inches, to the end of the legs 32. It is a native of the east. But that formerly it was very frequent in Britain, appears by some of the old bills of fare: in the famous feast of Archbishop Neville, we find no less than a thousand asterides, egrets or egrittes, as it is differently spelt. Perhaps the esteem they were in as a delicacy during those days occasioned their extirpation in Britain; abroad they are still common, especially in the southern parts of Europe, where they appear in flocks. The scapulars and the crest were formerly much esteemed as ornaments for caps and head-pieces; so that aigrette and egret came to signify any ornament to a cap, though originally the word was derived from *aigre, a cause de l'aigreur de sa voix*.

10. The herodias, or cristata maxima of Catesby, is crested behind, has a dusky-coloured back, reddish thighs, and the breast speckled with oblong black spots. It is four feet and a half when erect; the bill is about eight inches from the angle of the mouth to the end of it; and the crest is made up of long, narrow, brown feathers, the longest being five inches in length, which it can erect and let fall at pleasure. It is a native of Virginia, and feeds not only upon fish and frogs, but on lizards, efts, &c.

11. The stellaris, or bittern, has a smooth head; it is variegated through the whole body with dark-coloured spots of different figures and sizes. It is a native of Europe, and inhabits chiefly the fen-countries. It is met with skulking among the reeds and sedges; and its usual posture is with the head and neck erect, and the beak pointed directly upwards. It will suffer persons to come very near it without rising; and has been known to strike at boys and at sportsmen, when wounded and unable to make its escape. It flies principally about the dusk of the evening, and then rises in a very singular manner, by a spiral ascent, till it is quite out of sight. It makes a very strange noise when it is among the reeds, and a different and a very singular one as it rises on the wing in the night. It builds its nest with the leaves of water plants on some dry clump among the reeds, and lays five or six eggs of a cinerous green colour. This bird and the heron are very apt to strike at the fowler's eyes when only maimed. The food of the bittern is chiefly frogs; not that it rejects fish, for small trouts have been met with in their stomachs. In the reign of Henry VIII. it was held in much esteem at British tables, and valued at one shilling. Its flesh has much the flavour of a hare, and nothing of the fishiness of that of the heron.

12. The violacea, or crested bittern of Catesby, has a white crest; the body is variegated with black and white, and bluish below. These birds are seen in Carolina in the rainy seasons: but in the Bahama Islands, they breed in bushes growing among the rocks in prodigious numbers, and are of great use to the inhabitants there; who, while these birds are young and unable to fly, employ themselves in taking them for the delicacy of their food. They are, in some of these rocky islands, so numerous, that in a few hours two men will load one of their *calapatches*, or little boats, taking them perching from off the rocks and bushes, they making no attempt to escape, though almost full grown. They are called by the Bahamians, *crab-catchers*, crabs being what they mostly subsist on; yet they are well-tasted, and free from any rank or fishy savour.

There are 67 other species enumerated by ornithologists.

Ardea (anc. geog.), a town of Latium, the royal residence of Turnus king of the Rutuli, (Livy); so called, either from the augury of the heron, (Hyginus); or from the excessive heat of the country, (Martial). It was a marshy, sickly situation, (Strabo, Seneca). It was built by Danaë, the mother of Perseus, (Virgil);

(Virgil); about five miles distant from the sea, and 20 from Rome: now a hamlet. It was a Roman colony, (Livy); the inhabitants called *Ardeates*. E. Long. 17. 49. Lat. 41. 30.

ARDEBIL, or ARDEVIL, a town of Persia, in the province of Aderbijan. It was taken and burnt by Jenghiz Khan in 1222, when most of the inhabitants were destroyed: but it has been since rebuilt; and is still ranked for dignity among the best cities of the kingdom, on account of its having been the residence and burying-place of some of the Persian kings; particularly the sepulchre of Sheik Sefi is at this place, to which the people resort in pilgrimage. He founded a place, which they call his kitchen, with a revenue sufficient to maintain 1000 poor people, and to feed them three times a-day. Three or four of the largest principal streets have shops, and are planted on each side with elms and linden trees, to keep off the excessive heat of the sun; but the houses are poorly built, with bricks dried in the sun: yet most of them, that are not in the bazars or market-places, have the pleasure and conveniency of a garden full of trees bearing fruit: and there are large spots in the out-parts of the town, where the houses are at a distance from each other, and the spaces between planted with trees, which render the city of a large extent. The meidan, or great square, is 300 paces long, and 150 broad, having shops all round; which, when this place was in a flourishing condition, were stored with all manner of valuable commodities.

Through the city there pass two branches of a rivulet, which have been sometimes enlarged by the melting of the snow on the mountains, that they have been forced to make canals to divert the stream. In the reign of Sha Abbas, it broke down the dykes, and carried away a great number of houses. The city is without walls, and is seated in the midst of a large plain encompassed with mountains, the highest of which lies westward, and is alway covered with snow. These render the air sometimes extremely hot, and at others intolerably cold, which occasion epidemical distempers, that carry off great numbers of people. The soil produces no fruit near the city but apples, pears, and peaches; and yet is good both for corn and pasture. The sheep are so numerous, that 100,000 have passed over the city-bridge in a day. There are here several sorts of mineral waters, which serve both for common bathing, and for the cure of various diseases; one of these is a sulphureous spring, whose exhalations render the circumambient air extremely disagreeable. There are three springs which produce as hot water as if it was boiling, and from which waters are conveyed to the public baths in the city. About half a league from the city, on the right hand of the public road, there is a pool of standing water, which is covered all over with salt like ice. E. Long. 47. 30. N. Lat. 37. 55.

ARDEN, the common name of forests among the Celtæ, from the wildly extensive one which ranged for 500 miles in length across the country of Gaul, or covered more than half the county of Warwick in Britain, and the sites of which still retain the appellation of *Arden*, to the much smaller one of the ancient Mancenion, that covered and surrounded the site of the present Manchester. Written *Arduen* by Cæsar and Tacitus in speaking of the forest in Gaul, and *Ardven* by Ossian in mentioning the woods of Caledonia, it cannot (says Mr Whitaker) be compounded of *ar* the prepositive article in Celtic, and the substantive *den*, as Baxter and Cambden assert it to be; but is formed of *ard* an adjective, and *ven* the same as *den*. The meaning of the name therefore is not, as Mr Baxter renders it, simply *the hills*, or even, as the ingenious translator of Ossian interprets it, the *high hill*. *Ard* signifies either *high* or *great*, and *ven* or *den* either an *hill* or *wood*. *Arduen*, *Ardven*, or *Arden*, then, means a considerable wood. Hence, only, the name became applicable to such very different sites, as the *plains* of Warwickshire and the *hills* of Scotland: and it was given not only to the most extensive forests, to that which was the greatest in Gaul, or so considerable in Britain; but to many that were important only within their own contracted districts, as the wood of Mancenion abovementioned, and others.

ARDENBURG, a town of the Netherlands, in Dutch Flanders, and formerly the most considerable in that country; but has been dismantled by the Dutch. E. Lon. 3. 30. N. Lat. 51. 16.

ARDENNE, a forest in France, formerly of vast extent; but the trees are in many places grubbed up, and where they stood are built cities, towns, and abbeys. At present it extends from Thionville, near the country of Leige, to Donchery and Sedan, on the confines of Champagne. The roads are so narrow in some places, that two waggons cannot pass each other; and therefore the waggoners are obliged to provide themselves with bells or horns to give one another notice to stop in time.

ARDENTES, in middle-age writers, an appellation given to those afflicted with the Ignis Sacer, or Erysipelas. They were thus called, as seeming to be scorched or burnt with the disease. Hence also the abbey of St Genevieve at Paris is called *Domus Ardentium*, by reason, as it is said, that great numbers were cured of that distemper at the shrine of this saint, in the reign of Lewis VI.

ARDES, a town of France, in Lower Auvergne, and the principal place of the duchy of Mercœur. It serves as a mart for the commodities and trade between Upper and Lower Auvergne. E. Long. 3. 10. N. Lat. 45. 22.

ARDFERT, a town of Ireland, was the ancient capital of Kerry, with an university, which was held in the highest esteem. It is a bishop's see, and borough by ancient prescription, and has been held *in commendam* with the bishopric of Limerick ever since the Restoration. The bishops were anciently called Bishops of Kerry. St Brandon, to whom the cathedral is dedicated, had his first education in this county, under Bishop Ert; but he finished his studies in Connaught, St Jarlath bishop of Tuam being his preceptor. The ruins here are very extensive. Near the Cathedral was an anchorite tower, the loftiest and finest in the kingdom, being 120 feet high: it fell suddenly in 1771. In the ruined churches there are several inscriptions round the mouldings of the tomb-stones: and over an arch, behind Lord Glandore's house, is an inscription in relief done in a masterly manner, but the characters unknown.

ARDRAH, a small territory or kingdom of Africa, in Guinea, properly so called. It lies at the bottom of the gulph of St Thomas, and has a town called *Ardres*, supposed to be the capital. The inhabitants are very licentious, and have neither temple nor any place for religious worship. However, they are very courageous; and their king was absolute till lately that the king of Dahomay made war upon this and the neighbouring territories, brought them under subjection, and burnt the towns, particularly Ardres. The air is very unwholesome to Europeans; yet the natives live to a great age; but the small-pox makes great destruction among them. This country is fertile in Indian corn, palm-wine, plants, and fruits, which last all the year; and they make a great deal of salt.

ARDRES, a small but strong town of France, in Lower Picardy. Here was an interview between Francis I. and Henry VIII. king of England in 1520. It is seated in the midst of a morass. E. Long. 2. 0. N. Lat. 50. 35.

ARDS, barony of, in the county of Down in Ireland: it is a narrow slip of land, in some places three, and in none above six, miles broad; but the soil is for the most part tolerably good. It lies between the lake of Strangford and the sea, and in the south part it is opposite to Lycale. Sir Thomas Smith obtained a patent for this barony from Queen Elizabeth, and sent his natural son with a colony to possess it; but he was intercepted and slain by an Irishman. After Sir Thomas's death, Ards was granted by James I. to some of the Scots nobility.

ARDUBA, an ancient city of the Pannonians. It was taken by Germanicus about the 7th year of the Christian æra; but its reduction was more owing to the disagreement that reigned among the inhabitants than to the valour of the Romans. The greater part of the citizens were for submitting; but the women, more fond of their ancient laws and liberties than the men, joined some Roman deserters, and falling upon their husbands, killed a great number of them: but being at last overcome by the men, who then submitted to the Romans, the women either threw themselves headlong from the tops of the walls, or, setting fire to their houses, burnt themselves and their children to death.

AREA, in general, denotes any plain surface, whereon we walk, &c. The word is Latin, importing more properly a threshing-floor; and is derived from *arere*, "to be dry."

Area, in architecture, denotes the space or site of ground on which an edifice stands. It is also used for inner courts, and those portions of ground.

Area, in geometry, denotes the superficial content of any figure. Thus, if a figure, *e. g.* a field, be in form of a square, and its side be 40 feet long, its area is said to be 1600 square feet; or it contains 1600 little squares, each a foot every way.

AREB, a kind of imaginary money used in the dominions of the great mogul. Four arebs are equal to one crou, or 100 lacs; one lac to 100,000 roupees.

AREBO, or Arebon, a town on the slave-coast of Guinea, in Africa, seated at the mouth of the river Formoso. The English had once a factory there, as the Dutch have still. It is a large oblong place, indifferently well peopled, and furnished with houses built of reeds and leaves. E. Long. 5. 5. N. Lat. 5. 0.

ARECA, the Fausel-nut, in botany, a genus of the order of palmæ pennatifoliæ. The male has no calyx, but three petals, and nine stamina; the female has no calyx; the corolla has three petals, and the calyx is imbricated. There are two species, viz.

1. The cathecu, a native of India. This has no branches, but its leaves are very beautiful: they form a round tuft at the top of the trunk, which is as straight as an arrow. It grows to the height of 25 or 35 feet, and is a great ornament in gardens. The shell which contains the fruit is smooth without, but rough and hairy within; in which it pretty much resembles the shell of the cocoa nut. Its size is equal to that of a pretty large walnut. Its kernel is as big as a nutmeg, to which it bears a great resemblance without, and has also the same whitish veins within when cut in two. In the centre of the fruit, when it is soft, is contained a greyish and almost liquid substance, which grows hard in proportion as it ripens. The extract of this nut has been supposed to be the terra japonica of the shops, at least that it is a very similar substance both in colour and taste: But according to later observations, the genuine drug seems to be obtained from the *Mimosa Catechu*. The fruit when ripe is astringent, but not unpalatable, and the shell is yellowish. Of this fruit there is a prodigious consumption in the East Indies, there being scarce any person, from the richest to the poorest, who does not make use of it; and the trade they drive in it is incredible. The chief use that is made of areca is to chew it with the leaves of betel, mixing with it lime made of sea-shells.* In order to chew it, they cut the areca into four quarters, and take one quarter of it, which they wrap up in a leaf of betel, over which they lay a little of the lime; afterwards they tie it, by twisting it round. This bit prepared for mastication is called *pinang*; which is a Malayan word used all over the East Indies. The pinang provokes spitting very much, whether it be made with dried or fresh areca; the spittle is red, which colour the areca gives it. This mastication cools the mouth, and fastens the teeth and gums. When they have done chewing the pinang, they spit out the gross substance that remains in the mouth. They are under a mistake who imagine that fresh areca melts entirely in the mouth. Nor is it a less mistake to think that the teeth which are tinged red during the time of chewing, always retain that colour. As soon as they have done chewing the pinang, they wash their mouth with fresh water, and then their teeth are white again. The Europeans who live at Batavia, or Malaca, and in the Sunda and Molucca islands, use pinang as much as the Indians do; and by washing their teeth they preserve them white. Some pretend that areca strengthens the stomach, when the juice of it is swallowed, as most of the Indians do. Another property ascribed to it is, its curing or carrying off all that might be unwholesome or corrupt in the gums. When eaten by itself, as is sometimes done by the Indians, it impoverishes the blood, and causes the jaundice; but is not attended with these inconveniences when mixed in the usual way with betel. The Saimese call it *plou* in their language. The best areca of the Indies comes from the island of Ceylon The Dutch East-India company send a great deal of it in their ships into the kingdom of Bengal. There grows in Malabar a sort of red areca, which is very proper for dyeing in that colour. The same company send some

* Cornelius le Brun asserts, that they rub the leaves of betel with a red drug of Siam, or with white chalk.

Areca. some of it from time to time to Surat and Amadabat, for the use of the dyers in the dominions of the Grand Mogul.

2. The oleracea, or true cabage-palm, is the most beautiful, and perhaps the tallest, of all trees. The trunk is perfectly straight, and marked with rings at the vestigiæ of the footstalks of the leaves. Near the ground it is about seven feet in circumference; but tapers as it ascends, and attains the height of 170 or 200 feet. The bark is of an ash colour till within 25 or 30 feet of the extremity of the tree; when it alters at once to a deep sea-green, which continues to the top. About five feet from the beginning of the green part upwards, the trunk is surrounded with its numerous branches in a circular manner; all the lowermost spreading horizontally with great regularity; and the extremities of many of the higher branches bend wavingly downwards, like so many plumes of feathers. These branches, when full grown, are 20 feet long, more or less; and are thickly set on the trunk alternately, rising gradually superior one to another: Their broad curved sockets so surround the trunk, that the sight of it, whilst among these, is lost, which again appears among the very uppermost branches, and is there inveloped in an upright green conic spire, which beautifully terminates its great height. The above-mentioned branches are somewhat round underneath, and slightly grooved on the upper side: They are likewise decorated with a very great number of green pennated leaves: Some of these are near three feet long, and an inch and an half broad, growing narrower towards their points, as well as gradually decreasing in length towards the extremities of the branches. As there are many thousand leaves upon one tree: every branch bearing many scores upon it, and every leaf being set at a small and equal distance from another, the beauty of such a regular lofty group of waving foliage, susceptible of motion by the most gentle gale of wind, is not to be described. The middle rib, in each leaf, is strong and prominent, supporting it on the under side, the upper appearing smooth and shining. The pithy part of the leaf being scraped off, the inside texture appears to be so many longitudinal thread-like filaments. These, being spun in the same manner as they do hemp, or flax, are used in making cordage of every kind, as well as fishing-nets, which are esteemed stronger than those usually made from any other material of the like nature.

Upon removing the large leaves, or branches, which surround the top of the trunk a little way above the beginning of the green bark just mentioned, what is called the *cabbage* is discovered lying in many thin, snow-white, brittle flakes, in taste resembling an almond, but sweeter. This substance, which cannot be procured without destroying the tree, is boiled, and eaten with mutton by the inhabitants of the West Indies, in the same manner as turnips and cabbage are with us; though it must appear the height of extravagancy and luxury to fell so stately a tree, which would be an ornament to the most magnificent palace in Europe, to gratify the taste of an epicure, especially as there is but a very small part of it eatable. What is called the *cabbage-flower*, grows from that part of the tree where the ash-coloured trunk joins the green part already described. Its first appearance is a green husky spatha, growing to above 20 inches long and about four broad; the inside being full of small white stringy filaments, full of alternate protuberant knobs, the smallest of these resembling a fringe of coarse white thread knotted: these are very numerous, and take their rise from larger footstalks: and these footstalks likewise are all united to different parts of the large parent-stalk of all. As this husky spatha is opened while thus young, the farinaceous yellow seed in embryo, resembling fine saw-dust, is very plentifully dispersed among these stringy filaments, which answer the use of apices in other more regular flowers: these filaments being cleared of this dust, are pickled, and esteemed among the best pickles either in the West Indies or in Europe. But if this spatha is not cut down and opened whilst thus young; if it be suffered to continue on the tree till it grows ripe and bursts; then the inclosed part, which whilst young and tender is fit for pickling, will by that time have acquired an additional hardness, become soon after ligneous, grow bushy, consisting of very many small leaves, and in time produce a great number of small oval thin-shelled nuts, about the bigness of unhusked coffee-berries: These being planted, produce young cabbage-trees.

The sockets or grooves, formed by the broad part of the footstalks of the branches, are used by the negroes as cradles for their children. On the inner side of the very young footstalks are tender pellicles, which when dried, it is said, make a writing paper The trunks serve as gutterings; the pith makes a sort of sago; and the nuts yield oil by decoction. In the pith also, after the trees are felled, there breeds a kind of worms, or grubs, which are eaten and esteemed a great delicacy by the French of Martinico, St Domingo, and the adjacent islands. These worms, says father Labat, are about two inches long, and of the thickness of one's finger; the head is black, and attached to the body without any distinction of neck. Their preparation for the table is as follows: They are strung on wooden skewers before a fire; and as soon as heated, are rubbed over with raspings of crust, salt, pepper, and nutmeg: this powder absorbs all the fat, which during the cookery would otherwise escape; when properly roasted, they are served up with orange or citron sauce. These worms being exposed for some time to the sun, are said to yield an oil which is of great efficacy in the piles. The oil in question, says Labat, is never to be heated before its application to the part affected; as repeated experiments have evinced that its spirit is totally dissipated by the fire.

Arelate. ARELATE, or ARELATUM, is a town of Gallia Narbonensis, situated on the Rhone, denoting a town on, or beyond, a marsh, according to the particular situation of the speaker; called *Arelate Sextanorum*, (Pliny, Mela, Coin), because it had a colony of the sixth legion. Writers of the lower age call it *Arelas, atis*, (Prudentius, Ausonius). There was a double Arelas, one on each side of the river and joined by a bridge, (Ausonius); that on the left side is thought to have been built by Constantine. Tiberius's fa her was sent by Julius Cæsar at the head of the colony, (Suetonius); and hence the appellation *Julia Paterna*, as appears from an inscription. It was the favou-

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rite place of the Romans, and greatly ornamented; and hence called *Gallula Roma*. (Ausonius). It is now called *Arles*. E. Long. 5. 5. Lat. 43. 40.

AREMBERG, a small town of Germany, in the circle of Westphalia, defended by a castle. It is the capital of a county of the same name, and was erected into a principality by the Emperor Maximilian II. in favour of John de Ligne, lord of Barbazon, who took the name of *Aremberg*. It is seated on the river Ayr. E. Long. 7. 3. N. Lat. 50. 27.

AREMORICA, or ARMORICA, a part of Gaul, between the Sequana and Ligeris, (Cæsar, Hirtius); denoting a country on, or beyond the sea, *ar moer*, or *are moer*, Celtic. Pliny indeed says, that *Aquitania* was formerly called *Aremorica*; but in this he stands alone. In the lower age, the term *Armorica* was confined to Bretagne in France.

ARENA, in Roman antiquity, a place where the gladiators fought; so called from its being always strewed with sand, to conceal from the view of the people the blood spilt in the combat. Nero is said to have strewed the Arena with gold dust.

ARENARIA, or SANDWORT, in botany: A genus of the decandria trigynia class; and in the natural method ranking under the 22d order, *Caryophyllæ*. The calyx has five open leaves; the petals are five, and entire; the capsule is unilocular, and contains many seeds. There are 17 species of arenaria, only seven of which are natives of Britain, viz. the peploides, or sea-sandwort; the trinervis, or plantain-leaved sandwort; the serpylli-folia, or least sandwort; the saxatilis, or mountain-sandwort; the laricifolia, or larchleaved sandwort; the tenuifolia, or fine-leaved sandwort; and the rubra, or purple-flowered sandwort.

ARENACUM, or ARENACUS, one of the four towns or larger villages in the island of the Batavi, (Tacitus). Now *Arnheim*, in Guelderland. E. Long. 5. 20. N. Lat. 52. 2.

ARENARII, in antiquity, gladiators who combated with beasts in the arena, or amphitheatre. The arenarii were slaves of the lowest rank; so that, tho' manumitted, they were not capable of being Roman citizens. They were the same with what were otherwise called *Bestiarii*.

ARENARIUM, in ecclesiastical writers, denotes a cemetery or burying-ground. The arenaria were properly a kind of pits, or holes under ground, wherein the ancient Christians not only buried their dead, but held their religious assemblies in times of persecution.

ARENSBERG, a small town of Germany, in the circle of Westphalia, upon the river Roer. E. Long. 8. 20. N. Lat. 51. 25.

ARENSBOURG, an episcopal and maritime town of Livonia in Sweden, seated in the isle of Osel, in the Baltic Sea. E. Long. 22. 40. N. Lat. 58. 15.

AREOLA, among anatomists, the coloured circle surrounding the nipple of the breast.

AREOPAGUS, a sovereign tribunal at Athens, famous for the justice and impartiality of its decrees, to which the gods themselves are said to have submitted their differences. It was in the town, on a rock or hill opposite to the citadel. The word signifies strictly, *rock of Mars*.

Plutarch attributes the establishment of the Areopagus to Solon. Other authors think differently: and with good reason; for it appears undeniable, that this tribunal was instituted before Solon. But the best authorities allow him the honour of its restoration. The city of Athens, governed till this time by tribunals of a circumscribed jurisdiction, which were multiplied by the most trifling accidents and circumstances, took no fixed political or civil form, however closely united the members of those tribunals were by their general views towards the public good, and by the common love of their country. As each of those tribunals could only act in proportion to the power delegated to it, it was impossible that so many different and unequal impressions should give to the great machine of the state that uniform and regular movement which, by an impulse always the same, would keep each part in the situation it should maintain with relation to the whole.

To effect this universal and harmonious power, it was necessary to unite the different channels of public authority, which, by being too much distributed, lost its force. This authority Solon collected, and placed it all in the court of Areopagus, which consequently became the main spring of the government. The judges of this court, who, under Draco, decided only in cases of murder, now took cognizance of crimes of every kind; and the same tribunal which inflicted capital punishment on murder, poisoning, burning of houses, theft, &c. struck at the roots of those crimes, by arraigning idleness, luxury, and debauchery. Equally attentive to stimulate the indolence of the young, and the languor of the old, these sage judges roused in the one the laudable ambition to serve the state, and restored to the others their former activity. Satisfied that extremes produce the same effects, they thought the republic had as much to fear from the excess of wealth as from the gripe of poverty. Hence they exacted a minute account of the effects of every individual. Hence their great severity to those idle citizens, who, instead of being useful members in a state, are its bane and its dishonour. Isocrates draws a most beautiful and striking picture of those venerable and astonishing men, and of the order and harmony which flourished in Athens by their wise administration.

The judges of the Areopagus, says that author, were more industrious to prevent crimes, by representing them in an odious light, than to establish modes of punishment. It was their opinion, that the enemies of the state were the instruments destined by the gods to punish the wicked; but that it was their province to correct and reform public and private manners. They were vigilantly attentive to the conduct of all the citizens, but particularly to that of the youth. They well knew that the impetuosity of juvenile passion gave the most violent shocks to health and growing virtue; that it was the duty of inspectors of education to soften the austerity of moral discipline with innocent pleasure; and that no recreations were more eligible than bodily exercises, which enable a young man to give a good education its full play, which improve health, give a pleasurable and agreeable vivacity, and even fortify the mind. The fortunes of the Athenians were too unequal to admit the same mode of education; and therefore the youth were trained in a manner suitable to the rank and circumstances of their respective fami-

 lies.

Areopagus. lies. Those of the inferior class were taught agriculture and commerce; from this principle, that idleness is followed by indigence, and that indigence excites to the most daring and attrocious crimes. Having thus endeavoured by wise precautions, to preclude the entrance of moral evil, they thought they had little to fear.

Exercises of the body, such as horsemanship and hunting, were objects of education to the youth of liberal fortune. In this sage distribution, their great aim was to prevent the poor from committing crimes, and to facilitate to the rich the acquisition of virtue. Not satisfied with having established good laws, they were extremely careful to see that they were observed. With this view, they had divided the city into quarters, and the country into cantons. Thus every thing passed under their eyes; nothing escaped them; they were acquainted with the private conduct of every citizen. Those who had been guilty of any irregularity were cited before the magistrates, and were reprehended, or punshed in proportion to their misdemeanour.

The same Areopagites obliged the rich to relieve the poor. They repressed the intemperance of the youth by a severe discipline. Corruption in magistrates was suppressed by the punishments denounced against it; and the old men, at the sight of the employments of the young, felt themselves animated with a degree of juvenile vigour and activity.

Religion came likewise under the cognizance of the Areopagites. Plato durst never, as we are told by Justin Martyr, divulge his private opinion concerning the Deity. He had learned from the Egyptians the docrine of Moses. It appeared to him the best, and he embraced it with ardour. But his dread of the Areopagites, who were attached to the prevailing system, would not permit him even to name the author of sentiments which opposed the common tradition.

The public edifices, the cleanness of the streets, the pay of the soldiers, the distribution of the public money; in a word, whatever interested the republic, was under the direction of the Areopagus. The people themselves, jealous as they were of their power, did nothing without consulting this assembly, and suffered it, without a murmur, to amend their precipitate decrees. Yet this authority, however great it may seem, was subject to the laws; by them rewards and punishments were determined; and those respectable judges gave an account of the exercise of their trust to public censors, who were placed betwixt them and the people, to prevent the aristocracy from growing too powerful.

The most important qualifications were required in those who entered into the Areopagus. Solon made a law, by which they who had not been archons for a year should not be admitted members of the Areopagus. To give more force to his law, he subjected himself to it, and was only admitted on that title. This was but the first step; those annual magistrates, after having given law to the republic, were interrogated on their administration. If their conduct was found irreproachable, they were admitted Areopagites with eulogiums; but the smallest misconduct excluded them from that honour for ever. What administration was not to be expected from a tribunal so well composed? what veneration was not due to men of such rare talents and virtue? Such respect was paid them, that people presumed not to laugh in their presence; and so well established was their reputation for equity, that those whom they condemned, or dismissed without granting their petition, never complained that they had been unjustly treated. Areopagus.

The edifice of the Areopagus was extremely simple; and its roof, which was at first of the most common materials, remained in that state till the time of Augustus. This we learn from Vitruvius. Orestes was the first who thought of embellishing it. He raised in it an altar to Minerva. He likewise adorned it with two seats of solid silver; on one of which the *accuser* sat, and the *accused* on the other. The one seat was consecrated to *Injury*, and the other to *Impudence*. This religious sketch was brought to perfection by Epimenides, who erected altars to those allegorical deities, and soon after a temple, which Cicero mentions in his second book of laws. This temple corresponded with that which Orestes had built to the Furies, who brought him to Athens, and procured him the protection of Minerva. Epimenides dedicated it a second time to the Furies, or *severe Godesses*, as they were termed by the Athenians. A man was thought lost without resource, and a victim to every human ill, if he enforced a perjury by invoking the sacred name of those tremendous divinities.

Those who employed their thoughts in solving the mysteries of Paganism, imagined that the Eumenides had their temple so near the court Areopagus, that they might enlighten the judges by their inspiration, and, by their continual assistance, prevent them from committing those errors to which human weakness is liable. To propitiate those terrible deities, and to procure their favour for the Areopagus, they were worshipped with great punctuality and devotion; and the senate itself appointed their priests. Demosthenes had been nominated to preside over their sacrifices; and he thought it very extraordinary, that he, to whom the republic had confided so important an office, should be publicly impeached.

It was natural to associate with the Eumenides the other deities who shared with them the sovereign empire over the dead. Epimenides placed in their temples the statues of Pluto, of Mercury, and of Tellus. They were all, according to Pausanias, of an agreeable form. Each of them was placed upon an altar, on which the citizens, or strangers, who had been acquitted by the Areopagus made their grateful offerings. But it was not to gratitude alone that these several deities owed all the incense that smoked upon their altars. They who had been accused before the senate, harassed with superstition, and uncertain how these deities would be affected towards them, were lavish of sacrifices to obtain their clemency, by which they hoped their judges would likewise be influenced.

The tomb of Oedipus was another of the ornaments of the Areopagus. It was in the outward court of the Areopagus, where a barge was likewise placed, which made part of the pomp at the public games.

Whatever homage and implicit obedience the court of Areopagus might derive from all this religious parade, the public good was always dearer to them than

Areopagus. than any lower advantages they might have drawn from the altars and temples with which they were surrounded.

The senate assembled in a hall built on the summit of a hill, which was ascended with difficuly by the old men bent with age. However, as for some time they only assembled on the three last days of each month, they bore with patience this inconvenient situation. But public affairs multiplied to such a degree, that they were obliged to add to the three former sittings a fourth, which was held on the seventh day of the month, and which was soon succeeded by an assembly every day. Their meetings were so regular, that they were not interrupted by the most solemn festivals, till Cephisodorus was archon, who, in the third year of the 105th Olympiad, made a decree, which obliged the Areopagites to celebrate, after the example of the other courts, the Apaturian feasts, which lasted five days.

This assiduous and painful exercise of their office made the Areopagites feel all the inconvenience of the situation of their tribunal, and determined them to remove it to a part of the city called the *Royal Portico*. It was a square exposed to all the inclemencies of the weather. When the judges, who assembled there in profound silence, had taken their places, they were inclosed by a thread, or rather a cord, drawn around them.

They held their assemblies in the night, that their attention to public affairs might not be diverted by external objects,—and (adds Lucian) that they might only be influenced by the arguments, and not by the presence and action, of the speakers. This circumstance explains a passage in Athenæus, who tells us, that none knew the numbers nor faces of the Areopagites. The custom of administering justice in the open air was not peculiar to them. It was followed by all the other tribunals when they tried for murder; for two reasons:—1st, That the judges, the sworn protectors of innocence, might not be hurt by being under cover with criminals, whose hands were polluted with blood. 2dly, that the accuser and the accused might not be under the same roof.

When all the members of the senate were convened, a heral enjoined silence, and ordered the people to retire. As soon as they had departed, the Assembly proceeded to business; and as they deemed the least preference a flagrant injustice, the causes which they were to determine were drawn by a kind of lottery; and the same chance which brought them up, distributed them to different numbers of judges, small or great, according to the importance of the several causes.

In early times, the parties themselves stated their cause in a simple manner. The eloquence of advocates was thought a dangerous talent, fit only to varnish crimes. But afterwards the Areopagus, on this point, relaxed from their severity;—at first the accused, and soon after the accusers, were permitted to engage those to make the attack and the defence, whose profession it was to exert the art of speaking, for others, with accuracy and elegance.

Sextus Empiricus seems not to have sufficiently distinguished times, where he says, that the court of Areopagus did not suffer those who are to be tried at their bar to avail themselves of the abilities of others. What undoubedly led him into that mistake, was an Areopagus. inviolable custom of that tribunal, which prohibited, in pleadings, all that warm and picturesque oratory which seduces the judgment and inflames the passions. When the suffrages were collected, each person gave his in silence. They voted with a small flint, which they held betwixt the thumb and the two next fingers, and which they put into one of the two urns that stood in a corner of the hall. One stood before the other. The first was called the *urn of death*; the second, the *urn of compassion*. That of death was of brass, and was termed *proper*; that of compassion was of wood, and was termed *improper*. The judges commonly brought their flint to the assembly, and put it into the urn; but, that all the suffrages might be collected, the herald took the two urns, and presented them, one after another, to every senator, commanding him, in the name of the republic, no longer to defer his acquittal or condemnation.

For this method of giving sentence, which was called κρυϐδὴν ψῆφος, because it kept the vote of each person undiscovered, the Thirty Tyrants, to make themselves masters of the decisions of the Areopagus, substituted another, by means of which they knew exactly the opinion of each of the judges; for they obliged them to bring their flints publicly, and lay them upon two tables placed before them, the situation of which was quite opposite to that of the urns; for the first of those tables was that of *life*, and the second that of *death*.

The first substances with which they gave their suffrages were not small pieces of the bones of a hog, as some authors assert, but sea-shells, for which pieces of brass of the same form, termed *spondyla*, were afterwards substituted. The substances with which they voted were distinguished by their form and colour. Those which condemned were black, and perforated in the middle; the others were white, and not perforated. The precaution of piercing the black ones tends to prove, what we have already observed, that the court of Areopagus sat in the night: for what end did it serve to pierce the black shells, or flints, if the judges could have seen them and the white ones, and consequently have distinguished their colours by the assistance of the light? But as they passed sentence in the dark, it is evident that a difference besides that of colour was necessary, to know the black ones from the white. The judges were likewise permitted to multiply at pleasure the distinctions between signs, which essentially distinguished the fates of men.

After the suffrages were collected, they were taken out of the two urns, and put into a third vase of brass. They were then counted; and as the number of white or of black flints was higher or inferior, one of the judges drew with his nail a shorter or a longer line on a tablet with a waxen surface, on which the result of each cause was marked. The short line expressed acquittal; the long, condemnation.

With regard to the emoluments of the judges, they were as moderate as those of the advocates. The length of the process did not enhance its expence; and when the decision of a cause was postponed till the next day, the committee were only paid an obolus on that day. Hence Mercury, in Lucian, is surprised that such sensible old men as the senators of Areopagus were ſhould ſell at ſo low a price the trouble of aſcending ſo high.

As to the number of the judges which compoſed the Areopagus, ſome authors, attentive only to a part of Solon's regulations, by which he enacted, that for the future, none but the nine archons ſhould be admitted members of the Areopagus, have imagined, that this tribunal was filled anew every year, and that it never conſiſted of more than nine magiſtrates. This opinion, and ſome others, are refuted by the circumſtantial account which Diogenes Laertius gives us of the condemnation of Socrates. This great man had wiſhed to ſubſtitute a rational hypotheſis for the fabulous and extravagant ſyſtem of religion which prevailed in his time. His project, however laudable, appeared impious in the eye of ſuperſtition. Information was laid againſt him before the Areopagus, and he had as many accuſers as fellow-citizens. After the charges and the anſwers were heard, they proceeded to ſuffrages. The opinions were divided, but not equally, for the number of thoſe who condemned him exceeded by 281 the number of thoſe who declared him innocent. He made an ironical reply to this iniquitous ſentence, by telling his judges, that he took it for granted, they would admit him to a maintenance in the Prytanæum. On this ſarcaſm, 80 of thoſe who had voted in his favour forſook him, went over to the oppoſite party, and condemned him to die. Here then we have 361 judges who condemn; to whom if we add thoſe who perſiſt in aquitting him, the number muſt be very conſiderable.

Of all the judgments of the Areopagus, the moſt famous one, excepting that of Mars, was the ſentence which they paſſed on Oreſtes. His trial, which happened under Demophon the 12th king of Athens, in 375 of the Attic æra, owed all its fame to a remarkable circumſtance, that gave riſe to a cuſtom which was obſerved ever afterwards. Oreſtes had killed his mother. He was accuſed before the Areopagus, and cited to appear in that court. He would have loſt his life in conſequence of the equal diviſion of the votes, had not Minerva, moved with his misfortunes, declared herſelf for thoſe who had abſolved him, and joined her ſuffrage to theirs. Thus Oreſtes was ſaved. In veneration to this miracle, the Areopagites, whenever the ſuffrages were equally divided, decided in favour of the accuſed, by granting him what they termed *the ſhell of Minerva*. Cephalus and Dædalus were condemned by the Areopagus long before the time of Oreſtes.

We find in ancient authors ſome deciſions of this tribunal, which bear the ſtrongeſt marks of juſtice, though their objects are not intereſting. We ſhall here quote an anecdote from Aulus Gellius, and Valerius Maximus, of a woman who was accuſed of having poiſoned her huſband and her ſon. She was taken and brought before Dolabella, who was then proconſul of Aſia. She was no ſooner in his preſence than ſhe owned the fact; and added, that ſhe had very good reaſons for putting her huſband and her ſon to death.—"I had (ſaid ſhe) to my firſt huſband, a ſon whom I tenderly loved, and whoſe virtues rendered him worthy of my affection. My ſecond huſband, and the ſon whom I bare to him, murdered my favourite child. I thought it would have been unjuſt to have ſuffered thoſe two monſters of barbarity to live. If you think, Sir, that I have committed a crime, it is your province to puniſh it: I certainly ſhall never repent of it." This affair embarraſſed Dolabella. She was afterwards ſent to the Areopagus; and that court, when they had examined her a long time, ordered her and her accuſer to appear before them again a hundred years after, from the firſt day of her trial.

We muſt not, however, ſuppoſe that the Areopagus always preſerved its old reputation; for ſuch is the conſtitution of human affairs, that perfection, with regard to them, is a violent, and conſequently a tranſitory, ſtate. Pericles, who lived about 100 years after Solon, to flatter the people and win them to his party, uſed his utmoſt efforts to weaken the authority of the Areopagus, which was then diſliked by the multitude. He took from it the cognizance of many affairs which had before come under its juriſdiction; and, to forward his deſign of humbling it, employed the eloquence of Ephialtes, whoſe talents were formidable, and who was an avowed enemy to the great men of Athens.

The Areopagus itſelf ſeemed to ſecond the endeavours of a man who projected its ruin, and by its miſconduct haſtened its fall. The old rules of the court, by which none were admitted its members but thoſe whoſe unexceptionable conduct would ſupport its majeſty, ſeemed too ſevere. They grew leſs delicate in their choice, and preſuming that the faults with which they diſpenſed, would ſoon be reformed in the ſociety of ſo many good examples, vice imperceptibly crept among them: corruption, at firſt ſecret and timid, grew inſenſibly open and daring, and made ſuch progreſs, that the moſt ſhameful crimes were ſoon exhibited on the ſtage; and they were not copied from the low and abandoned multitude, but from thoſe ſenators, once the venerable and auſtere cenſors of idleneſs and of vice. Demetrius, the comic poet, wrote a piece which he intitled *The Areopagite*, where he ſtrips the maſk off thoſe hypocritical legiſlators, who were now equally apt to be ſeduced by wealth and by beauty. So much had the Athenian ſenate degenerated in the days of Iſocrates, cir. 340 years before the Chriſtian æra.

Before this tribunal St Paul was called to give an account of his doctrine, and converted Dionyſius one of their number.

The end of this court of judicature is as obſcure as its origin, which was derived from very remote antiquity. It exiſted, with the other magiſtracies, in the time of Pauſanias, i. e. in the 2d century. The term of its ſubſequent duration is not aſcertained; but a writer, who lived under the emperors Theodoſius the Elder and Younger, in the 5th century, mentions it as extinct.

AREQUIBA, a city of Peru in South America, ſituated in W. Long. 73°. S. Lat. 17°. It is one of the moſt beautiful cities in all Peru, being delightfully ſituated in the valley of Quilca, 100 leagues from Lima, and 20 from the ſea, with which it communicates by a fine river. The entrance into the harbour is rather ſhallow for ſhips of great burden; but when once they are entered, they may ride ſecurely in 18 fathoms water. This city was founded in 1539, by order of Don Franciſco Pizarro, in a place known likewiſe by the name of *Arequiba;* but its ſituation being found diſadvantageous, the inhabitants obtained leave to remove

move to the place where the city now ſtands. The houſes are built with ſtone, and vaulted; and, contrary to what is uſual in warm countries, they are lofty, neatly furniſhed within, and finely decorated on the outſide. The inhabitants alſo are exempt from many diſeaſes common in other parts of Peru; which perhaps is owing to their keeping the ſtreets clean by means of canals which extend to the river. The temperature of the air is extremely good; and though ſometimes a ſlight froſt is perceivable, the cold is never exceſſive, nor the heat troubleſome, ſo that the ſurrounding fields are clothed with perpetual verdure. Theſe natural advantages however, are conſiderably allayed by its being very ſubject to earthquakes, by which it has already been five times laid in ruins; notwithſtanding, which, it is populous, and has amongſt its inhabitants ſome of the nobleſt families in America.

ARES, a word of Paracelſus's, by which he would expreſs that power of nature in the whole material world, by which ſpecies are divided into individuals.

ARETÆUS of Cappadocia, a Greek phyſician, of the ſect of the Pneumatiſts, lived in the reign of Auguſtus, according to ſome; according to others, under Trajan or Adrian. He wrote ſeveral treatiſes in the Ionian dialect, on acute diſeaſes, and other medicinal ſubjects; ſome of which are ſtill extant. The beſt edition of his works is that of Boerhaave, in Greek and Latin, with notes, printed in 1731; that of Wigan, printed at Oxford in 1723, in folio, is alſo much eſteemed.

ARETHUSA, in fabulous hiſtory, the daughter of Nereus and Coris, and the companion of Diana, who changed her into a fountain to deliver her from the purſuit of her lover Alpheus.

Arethusa, a celebrated fountain near the city of Syracuſe in Sicily, famous for the quantity of its waters, and the number of fiſhes it contained. Many fables were invented by the ancients concerning this fountain. They had alſo a notion that the river Alpheus run under or through the waters of the ſea, without mixing with them, from Peloponneſus to Sicily. Mr Brydone informs us, that it ſtill continues to ſend forth an immenſe quantity of water, riſing at once to the ſize of a river, but is entirely abandoned by the fiſhes it formerly contained in ſuch plenty. At ſome diſtance from Arethuſa is a fountain of freſh water which boils up very ſtrongly in the ſea, inſomuch that, after piercing the ſalt water, it may be ſometimes taken up very little affected by it. This fountain Mr Brydone thinks the ancients were ignorant of, or they would not have failed to uſe it as an argument for the ſubmarine journey of Alpheus.

Mr Swinburn deſcribes this once famous fountain as a large pool of water near the quay, defended from the ſea by a wall, and almoſt hidden by houſes on every other ſide. The water is not ſalt, but brackiſh, and fit for no purpoſe but waſhing linen. "This (ſays he) is the celebrated fountain of Arethuſa, whoſe ſoft poetical name is known to every reader. The fable of the nymph and her conſtant lover Alpheus, the excellence of the ſpring, and the charms of its ſituation, are themes on which ancient and modern poets have indulged their fancy, and exerciſed their pens. Alas, how altered! rubbiſh chokes up its wholeſome ſources; the waves have found a paſſage through the rocks, which repeated earthquakes have ſplit; and not a fiſh to be ſeen in it. Sometimes, after an earthquake, it has been left dry; and, at other times, the whole maſs of its waters have been tainted by ſubterraneous effluvia. Its fountain-head probably lies among the neighbouring hills."

Arethusa, in botany: A genus of the gynandria diandria claſs; and in the natural method ranking under the 7th order, *Orchideæ*. The generic character is taken from the nectarium, which is tubular, ſituated at the bottom of the corolla, and the inferior labium fixed to the ſtylus. There are four ſpecies; all natives of America except the carpenſis, which is only found at the Cape of Good Hope.

ARETIA, in botany: A genus of the pentandria monogynia claſs; and in the natural method ranking under the 21ſt order, *Pretiæ*. The corolla is divided into five parts; the tube of the corolla is ovated; and the capſule is globular, and conſiſts of but one cell. There is only one ſpecies, viz. the alphina.

ARETIN (Guido), famous for his muſical improvements, lived in the 13th century. He was a native of Arezzo, a city in Tuſcany; and having been taught the practice of muſic in his youth, and probably retained as a choriſter in the ſervice of the Benedictine monaſtery founded in that city, he became a monk profeſſed, and a brother of the order of St Benedict.

In this retirement he ſeems to have devoted himſelf to the ſtudy of muſic, particularly the ſyſtem of the ancients, and, above all, to reform their method of notation. The difficulties that attended the inſtruction of youth in the church-offices were ſo great, that as he himſelf ſays, ten years were generally conſumed barely in acquiring the knowledge of the plain-ſong; and this conſideration induced him to labour after ſome amendment, ſome method that might facilitate inſtruction, and enable thoſe employed in the choral office to perform the duties of it in a correct and decent manner. If we may credit thoſe legendary accounts that are extant in old monkiſh manuſcripts, we ſhould believe he was aſſiſted in his pious intention by immediate communications from heaven: ſome ſpeak of the invention of the ſyllables as the effect of inſpiration; and Guido himſelf ſeems to have been of the ſame opinion, by his ſaying it was revealed to him by the Lord; or, as ſome interpret his words, in a dream: but graver hiſtorians ſay, that being at veſpers in the chapel of his monaſtery, it happened that one of the offices appointed for that day was the hymn† to St John,

UT queant laxis	*REſonare fibris*
MIra geſtorum	*FAmuli tuorum*
SOLve pollutis	*LAbiis reatum,*
	Sancte Joannes.

† Compoſed by Paul, a deacon of the church of Aquileia, about the year 770.

During the performance of the hymn, he remarked the iteration of the words, and the frequent returns of ut, re, mi, fa, sol, la: he obſerved likewiſe a diſſimilarity between the cloſeneſs of the ſyllable mi and the broad open ſound of fa, which he thought could not fail to impreſs upon the mind a laſting idea of their congruity; and immediately conceived a thought of applying the ſix ſyllables to perfect an improvement either then actually made by him, or under conſideration, viz. that of converting the ancient tetrachords into hexachords.

Struck with the discovery, he retired to his study; and having perfected his system, began to introduce it into practice: the persons to whom he communicated it were the brethren of his own monastery, from whom it met with but a cold reception, which, in the epistle to his friend, he ascribes undoubtedly to its true cause, envy: however, his interest with the abbot, and his employment in the chapel, gave him an opportunity of trying the efficacy of his method on the boys who were training up for the choral service, and it exceeded the most sanguine expectation. "To the admiration of all (says cardinal Baronius), a boy thereby learnt, in a few months, what no man, though of great ingenuity, could before that attain in several years."

The fame of Guido's invention soon spread abroad, and his method of instruction was adopted by the clergy of other countries. We are told by Kircher, that Hermannus bishop of Hamburg, and Elviricus bishop of Osnaburg, made use of it; and by the authors of the *Histoire Litteraire de la France*, that it was received in that country, and taught in all the monasteries in the kingdom. It is certain that the reputation of his great skill in music had excited in the pope a desire to see and converse with him; of which, and of his going to Rome for that purpose, and the reception he met with from the pontiff, he himself has given a circumstantial account of in the epistle hereafter mentioned.

The particulars of this relation are very curious; and as we have his own authority, there is no room to doubt the truth of it. It seems that John XX. or, as some writers compute, the 19th pope of that name, having heard of the fame of Guido's school, and conceiving a desire to see him, sent three messengers to invite him to Rome; upon their arrival, it was resolved by the brethren of the monastery that he should go thither attended by Grimaldo the abbot, and Peter the chief of the canons of the church of Arezzo. Arriving at Rome, he was presented to the holy father, and by him received with great kindness. The pope had several conversations with him, in all which he interrogated him as to his knowledge in music; and upon sight of an antiphonary which Guido had brought with him, marked with the syllables agreeable to his new invention, the pope looked on it as a kind of prodigy; and ruminating on the doctrines delivered by Guido, would not stir from his seat till he had learned perfectly to sing off a verse: upon which he declared, that he could not have believed the efficacy of the method, if he had not been convinced by the experiment he had himself made of it. The pope would have detained him at Rome; but labouring under a bodily disorder, and fearing an injury to his health from the air of the place, and the heats of the summer, which was then approaching, Guido left that city upon a promise to revisit it, and explain to his holiness the principles of his new system. On his return homewards, he made a visit to the abbot of Pomposa, a town in the duchy of Ferrara, who was very earnest to have Guido settle in the monastery of that place: to which invitation it seems he yielded, being, as he says, desirous of rendering so great a monastery still more famous by his studies there.

Here it was that he composed a tract on music, intitled *Micrologus*, i. e. "a short discourse;" which he dedicated to Theodald bishop of Arezzo; and finished, as he himself at the end of it tells us, under the pontificate of John XX. and in the 34th year of his age. Vossius speaks also of another musical treatise written by him, and dedicated to the same person.

Most of the authors who have taken occasion to mention Guido, speak of the Micrologus as containing the sum of his doctrine: but it is in a small tract, intitled *Argumentum novi Cantus inveniendi*, that his declaration of his use of the syllables, with their several mutations, and in short his whole doctrine of solmisation, is to be found. This tract makes part of an epistle to a very dear and intimate friend of Guido, whom he addresses thus, "Beatissimo atque dulcissimo fratri Michaëli;" at whose request the tract itself seems to have been composed.

Whether Guido was the author of any other tracts, is not easy to determine. It no where appears that any of his works were ever printed, except that Baronius, in his *Annales Ecclesiastici*, tom. xi. p. 73, has given at length the epistle from him to his friend Michael of Pomposa, and that to Theodald bishop of Arezzo, prefixed to the Micrologus; and yet the writers on music speak of the Micrologus as of a book in the hands of every one. Martini cites several manuscrips of Guido; namely, two in the Ambrosian library at Milan, the one written about the 12th century, the other less ancient; another among the archives of the chapter of Pistoja, a city in Tuscany; and a third in the Mediceo-Laurenziano library at Florence, of the 15th century: these are clearly the Micrologus. Of the epistle to Michael of Pomposa, together with the *Argumentum novi Cantus inveniendi*, he mentions only one, which he says is somewhere at Ratisbon. Of the several tracts abovementioned, the last excepted, a manuscript is extant in the library of Baliol-college in Oxford. Several fragments of the two first, in one volume, are also among the Harleian manuscripts now in the British Museum, N° 3199; but so very much mutilated, that they afford but small satisfaction to a curious inquirer.

Aretin (Leonard), one of the most learned men of the 15th century, was secretary to the republic of Florence, and translated from the Greek into Latin some of the Lives of Plutarch, and Aristotle's Ethics: he also composed three books of the Punic war, that may serve as a supplement to those wanting in Livy; the history of the transactions in Italy during his time; that of ancient Greece; that of the Goths; that of the republic of Florence; and many other books. He died in 1443, aged 74.

Aretin (Francis), a man of great reading, and well acquainted with the Greek language. He translated into Latin the Commentaries of St Chrysostom upon St John, and about 20 Homilies of the same father: he also translated the Letters of Phalaris into Latin, and wrote a treatise *De balneis Puteolanis*. He studied at Sienna, about the year 1443; and afterwards taught law there with such reputation, that they called him the *Prince of Subtleties*, and his wit became a proverb. He displayed his talents chiefly in disputes, in which nobody could withstand him. He gave his opinions in law with so much confidence, as to assure those who consulted him that they should carry their cause: nor did experience contradict him; for it was a common saying at the bar, such a cause has been condemned

demned by Aretin, it must therefore be lost. He taught also in the university of Pisa, and in that of Ferrara. He was at Rome under the Pontificate of Sixtus IV. but did not stay here long; for he soon perceived that the great hopes which he had built upon his reputation would come to nothing. This pope, however, declared he would have given him a cardinal's hat, had he not thought he should have done a public injury by depriving the youth of such an excellent professor. When old age would not permit him to go through the duties of his office, they dispensed with his reading of lectures, and his salary was continued. He continued, however, sometimes to mount the chair; and although his lectures had now but little spirit in them, yet he had still many hearers on account of his reputation. One day when the students were gone to some public shows, there were but 40 persons in his auditory: which so mortified him, that he threw away his book; and crying out, "Aretin shall never explain law to a few persons," retired in a passion, and would teach no more. He was severe in his temper, and never kept a servant longer than a month or two; for it was a maxim of his, "that new hired servants always serve best." He was honoured with the title of *knight*, and spent all his life in celibacy; and his way of living was so parsimonious, that he was thereby enabled to amass a great deal of wealth. He had designed this wealth for the maintenance of a college; but he altered his resolution, and left it to his relations.

Aretin (Peter), a native of Arezzo, who lived in the 16th century. He was famous for his satirical writings: and was so bold as to carry his invectives even against sovereigns, and from thence got the title of the *Scourge of Princes*. Francis I. the emperor Charles V. most of the princes of Italy, several cardinals, and many noblemen courted his friendship by presents, either because they liked his compositions, or perhaps from an apprehension of falling under the lash of his satire. Aretin became thereupon so insolent, that he is said to have got a medal struck, on one side of which he is represented by these words, IL DIVINO ARETINO; and on the reverse, sitting upon a throne, receiving the presents of Princes, with these words, I PRINCIPI TRIBUTATI DA POPOLI, TRIBUTANO IL SERVIDOR LORO. Some imagine that he gave himself the title of *Divine*, signifying thereby that he performed the functions of a god upon earth, by the thunderbolts with which he struck the heads of the highest personages. He used to boast, that his lampoons did more service to the world than sermons; and it was said of him, that he had subjected more princes by his pen than the greatest had ever done by their arms. Aretin wrote many irreligious and obscene pieces; such are his dialogues, which were called *Ragionamenti*. There is likewise imputed to him another very obscene performance, *De omnibus Veneris schematibus*. "It was about the year 1525 (says Mr Chevillier*) that Julio Romano, the most famous painter of Italy, instigated by the enemy of the salvation of mankind, invented drawings to engrave 20 plates: the subjects are so immodest that I dare only name them. Peter Aretin composed sonnets for each figure. George Vasari, who relates this in his Lives of the Painters, says, he does not know which would be the greatest impurity, to cast one's eyes upon the drawings of Julio, or to dip into the verses of Aretin." Some say that Aretin changed his libertine principles; but however this may be, it is certain that he composed several pieces of devotion. He wrote a Paraphrase on the penitential Psalms, and another on Genesis; he wrote also the Life of the Virgin Mary, and that of St Catherine of Sienna, and of St Thomas Aquinas. He was author likewise of some comedies. He died in the year 1556, being about 65 years old.

* *Origin de l'imprimerie de Paris*, p. 224.

ARETOLOGI, in antiquity, a sort of philosophers, chiefly of the Cynic or Stoic tribe, who, having no school or disciples of their own, haunted the tables of great men, and entertained them in their banquets with disputations on virtue, vice, and other popular topics. These are sometimes also denominated *Circulatores Philosophi*. In this sense, the word is derived from the Greek αρετη, *virtue*, and λογος, *discourse*. Some authors choose to derive the word from αρετος, *gratus*, "agreeable;" and define Aretologi, by persons who strive to divert and entertain their audiences with jokes and pleasant tales; which latter seems the more natural explication.

AREZZO, a city of Italy, in Tuscany, seated in the territory of Florence, on the declivity of a hill that overlooks the neighbouring plain, between the Citta di Castelli and Florence. It is an ancient city, and a bishop's see; and was famous for a kind of earthen ware much esteemed by the Romans. It was greatly fallen to decay when Cosmo de Medicis took it under his protection; since which it has been recovering gradually. It is famed for being the birth-place of Mecænas. E. Long. 12. 2. N. Lat. 43. 27.

ARGEA, or Argei, in Roman antiquity, thirty human figures, made of rushes, thrown annually by the priests or vestals into the Tiber, on the day of the ides of May.—Plutarch in his Roman Questions, inquires why they were called *Argea*. There are two reasons assigned. The first, that the barbarous nation who first inhabited these parts cast all the Greeks they could meet with into the Tiber: for Argians was a common name for all Grecians: but that Hercules persuaded them to quit so inhuman a practice, and to purge themselves of the crime by instituting this solemnity. The second, that Evander, an Arcadian, and a sworn enemy of the Argians, to perpetuate that enmity to his posterity, ordered the figures of Argians to be thus cast into the river.

ARGEIA, or Argolis, a district of Peloponnesus, situated between Arcadia to the west, the Egean Sea to the east, Laconica and the Sinus Argolicus to the south, and to the north the territory of Corinth and the Sinus Saronicus (Livy, Ptolemy); so called from Argos, the capital: Now *Romania di Morea*.

By the Greeks the people were called *Argeii*, from *Argi* or *Argos*; by the Romans, *Argivi*, Argives They were a colony who migrated, it is said, from Egypt, under the command of Inachus. Polemon and Ptolemy Mendesius, ancient Greek writers, inform us, that Inachus was contemporary with Amosis, who demolished Avaris, and expelled the shepherds out of Egypt. If, with some learned chronologers, we suppose Inachus to have begun to reform the Argives B. C. 1856, and to have died B. C. 1808, he must have been coeval with Amosis who reigned in Upper Egypt 15 years before the

the expulſion of the ſhepherds, and 10 years after that event, which happened B. C. 1806. Inachus was ſtyled the *Son of the Ocean*, becauſe his origin was not known, or becauſe he had come by ſea into Greece. Before his arrival the inhabitants were rude and barbarous. Theſe he united and civilized, and inſtructed in various arts. His ſon Phoroneus inſtituted the laws of government; and, on that account, has been called the *firſt king in Argos*, the *firſt of men*, and the *father of mortals*. The family of Inachus, after having kept poſſeſſion of the throne 347 years, were expelled by Danaus, who arrived B. C. 1509 with a colony from Canaan. Acriſius, the laſt king of Argos, died B. C. 1313; and was ſucceeded by Perſeus, his grandſon, who transferred the ſeat of government to Mycenæ, 544 years from the firſt year of Inachus, in the reign of Cecrops II. king of Athens, and about the time when Pelops the ſon of Tantalus king of Phrygia, having been compelled by Ilus to leave his native country, came into Greece with great wealth, and acquired ſupreme power in the region afterwards called by his name. In the 37th year of Euryſtheus, grandſon of Perſeus, the Argonautic expedition happened, i. e. B. C. 1224. This unjuſt and tyrannical prince had aſſigned to Hercules his taſk; and, after the death of that hero, he baniſhed all his children. Theſe were the Heraclidæ who fled to Athens for protection, and who returned to Peloponneſus 40 years after the deſtruction of Troy. In the reign of Agamemnon, the Trojan war commenced; and it was carried on with vigour during the ſpace of ten years. In the year B. C. 1184, Troy was taken, and the war was concluded. Scarcely had the Grecians ſettled in their own country after their return from this dangerous expedition, when the poſterity of Hercules invaded Peloponneſus, took poſſeſſion of it, and divided it among themſelves. Here the kingdom of Mycenæ ended, and that of Sparta was eſtabliſhed on its ruins. See SPARTA.

ARGEMONE, PRICKLY POPPY: A genus of the monogynia order, belonging to the polyandria claſs of plants; and in the natural method ranking under the 27th order, *Rhœadeæ*. The corolla conſiſts of ſix petals; the calyx is triphyllous; and the capſule is ſemivalved. Of this genus there are three ſpecies, which are common in many parts of the Weſt-Indies, and called by the Spaniards the *devil's fig*; but they are of no uſe, and have very little beauty.

ARGENCES, a town of France, in Lower Normandy, on the river Meance. W. Long. 0. 10. N. Lat. 49. 15.

ARGENT, the common French word for *ſilver*, of which metal all white fields or charges are ſuppoſed to conſiſt. Argent of itſelf is uſed in heraldry to ſignify purity, innocence, beauty, and gentleneſs; and, according to G. Leigh, if it is compounded with

Gul.	it ſignifies	boldneſs;
Azu.		courteſy;
Ver.		virtue;
Pur.		favour;
Sab.		religion;

ARGENTAC, a town of France, in the Limoſin, on the river Dordogne. E. Long. 2. 3. N. Lat. 45. 5.

ARGENTAN, a town of France in Lower Normandy, and in the dioceſe of the Seez, with the title of marquiſate. It is ſeated on an eminence, in the middle of a fertile plain, on the banks of the river Orne, and carries on a conſiderable trade. E. Long. 0. 5. N. Lat. 48. 54.

ARGENTARIA, a town of ancient Gaul, thought to ſtand in the place where the city Colmar now ſtands. It is remarkable for a great victory gained by the emperor Gratian over the Lentienſes, in the month of May, A. D. 378. The Romans being but few in number, were at firſt overpowered, and obliged to give ground; but ſoon returning to the charge, they gained in the end a complete victory. Thirty thouſand of the barbarians, and among the reſt their king Triarius were killed on the ſpot; and all the reſt, except 5000, taken priſoners.

ARGENTARIA Creta, pure white earth, found in Pruſſia, and much eſteemed for cleaning plate.

ARGENTARIUS is frequently uſed in Roman writers, for a money changer or banker. The argentarii were monied people, who made a profit either by the changing, or lending money at intereſt. Theſe had their *tabernæ*, or offices, in the *forum Romanum*, built there as early as the reign of L. Tarquinius Priſcus. The argentarii and fœneratores were much hated on account of their covetouſneſs and extortion.

ARGENTATI MILITES, in antiquity. Livy, lib. vi. ſpeaks of *argentati milites*, as diſtinguiſhed from *aurati*. Aquinas ſuppoſes theſe to have been ſimilar to the argyraſpides and chryſaſpides; but the deſcriptions do not quadrate. Livy only repreſents the argentati as cloathed in white linen coats.

ARGNTEUIL, a town of the Iſle of France, ſeated on the river Seine, five miles north-weſt of Paris. It is a very beautiful place, with fine vineyards. In the environs are quarries of ſtucco. In the Benedictine priory they pretended to have the ſeamleſs coat of Chriſt. E. Lon. 2. 28. N. Lat. 48. 52.

ARGENTIERE, a ſmall iſland in the Archipelago, near Milo. It is about 18 miles in compaſs; and is full of barren mountains, producing nothing but barley, cotton, and a few grapes fit only for eating. The barley and cotton are ſown round the only village there is in the iſland. The ladies are handſome enough, have no other employment but making cotton ſtockings, and take up with the ſailors who put into the port. The men all uſe the ſea, and in time become good pilots. They have very little religion, are very ignorant, and of very bad morals. Juſtice is adminiſtered by an itinerant cadi, who is ſometimes the only muſſulman in the whole iſland. The only article relating to natural hiſtory is the Terra Cimolia ſo highly eſteemed by the ancients; it is a kind of white chalk, which is very heavy without taſte, and crumbles eaſily: they uſe it in waſhing linen. E. Long. 23. 10. N. Lat. 36. 50.

ARGENTINA, in ichthyology, a genus of fiſhes belonging to the order of abdominales. The generic characters are theſe: The teeth are in the tongue as well as the jaws; the branchioſtege membrane has eight radii or rays; the anus is near the tail; and the belly-fins conſiſt of many rays. There are two ſpecies of argentina, viz. The ſphyræna has 15 rays in the fin at the anus; the air-bladder of this ſpecies is conical on both ſides, and ſhines like ſilver: according to Mr Ray, falſe pearls are ſometimes made of it. 2. The carolina has likewiſe 15 rays in the fin near the anus; the

Argentinus ‖ Argo. the tail is forked, and the lateral lines are straight. It inhabits the fresh waters of Carolina.

ARGENTINUS, a deity worshipped by the ancients, as the god of silver coin; as Æsculanus, whom they made his father, was the god of brass money, which was in use before silver.

ARGENTON, a town and county of France, in the duchy of Berry, divided into two by the river Creuse. Here was formerly a castle; but it was demolished by Lewis XIV. E. Long. 1. 38. N. Lat. 40. 30.

ARGENTORA, *Argentina*, (Notitiæ); *Argentoratum*, (Ptolemy); *Argentoratus*, (Ammian); a city of the Tribocci; one of the fifty forts built by Drusus on the Rhine, (Florus): an appellation formed by the Romans from the German, *Argen Strassen*, or *Straten*, "unsafe roads for travellers," from the maroding parties of the garrisons that infested the roads. Now *Strasburg*†, in the lower Alsace, on the rivulet Ill, near the Rhine. E. Long. 7. 35, Lat 48. 38.

† See *Strasburg*.

ARGENTUM. See SILVER.

ARGENTUM Album, in our old customs, silver coin, or pieces of bullion that anciently passed for money. By Doomsday tenure, some rents to the king were paid in *argento albo*, common silver pieces of money; other rents in *libris ursis et pensatis*, in metal of full weight and purity: in the next age, that rent which was paid in money, was called *blanch fearm*, and afterwards *white rent*; and what was paid in provisions, was termed *black mail*.

ARGENTUM Dei, God's penny, anciently signified earnest-money, or money given to bind a bargain; in some places called *erles*, or *arles*, and by the civilians and canonists, *arrhæ*. *Et cepit de prædicto Henrico tres denarios de argenti Dei præ manibus.*

ARGENTUM Musivum is a mass consisting of silver-like flakes, used for the colouring of plaster-figures, and for other purposes, as pigment. It consists of an amalgam of equal parts of tin, bismuth, and mercury. It is to be mixed with white of eggs, or spirit varnish, and then applied to the intended work, which is afterwards to be burnished.

ARGENTUM Vivum, Mercury or *Quicksilver*. See MERCURY and CHEMISTRY-*Index*.

ARGESTES, is used by Vitruvius for the wind which blows from that quarter of the horizon, which is 75° from the south, and westward. Ricciolus uses the term to denote the wind which blows at 22° 30′, from the west towards the north, coinciding with that which is otherwise called *west-north-west*.

ARGIL, in ornithology, a species of ardea. See ARDEA.

ARGILLA, clay in natural history. See CLAY.

ARGIVI, or ARGEII, the people of Argeia or Argolis. See ARGEIA.

ARGO, in antiquity, a ship or vessel celebrated among the poets; being that wherein the Argonauts, of whom Jason was the chief, made their expedition in quest of the golden fleece. Jason having happily accomplished his enterprise, consecrated the ship Argo to Neptune; or, as others say, to Minerva, in the Isthmus of Corinth; where, they add, it did not remain long before it was translated into heaven, and made a constellation. The generality of authors represent the ship Argo as of a long make, resembling the modern galleys; and furnished with thirty benches of rowers.

Argo ‖ Argonautic. It could not, however, be of any great bulk, since the Argonauts were able to carry it on their backs from the Danube to the Adriatic sea.

ARGO Navis, the *Ship Argo*, in astronomy, is a constellation in the southern hemisphere, whose stars, in Ptolemy's catalogue, are 45; in Tycho's, 11; in the Britannic catalogue, and Sharp's appendix, 64.

ARGOB, (anc. geog.), a canton lying beyond Jordan, in the half tribe of Manasseh, and in the country of Bashan, one of the most fruitful on the other side of Jordan. In the region of Argob there were sixty cities, called *Bashan-havoth-jair*, which had very high walls and strong gates, without reckoning many villages and hamlets which were not inclosed, Deut. iii. 4. 14, and 1 Kings iv. 13. But Argob was more particularly the name of the capital city of the region of Argob, which Eusebius says was fifteen miles west from Gerasa.

ARGONAUTA, the name of a genus of shell-fish belonging to the order of vermes testacea. The shell consists of one spiral involuted valve. There are two species of argonauta, viz. The argo, with a subdented carina, which is found in the Mediterranean and Indian oceans. This is the famous nautilus of authors. The shell seems no thicker nor stronger than a piece of paper; and the fish that inhabits it is a sepia. It has been imagined that men first learned the method of sailing in vessels from what they saw practised by this creature. When it is to sail, it extends two of its arms on high; and between these supports a membrane, which it throws out on this occasion: this serves for its sail; and the two other arms it hangs out of the shell, to serve occasionally either as oars or as a steerage; but this last office is generally served by the tail. When the sea is calm, it is common to see numbers of these creatures diverting themselves with sailing about in this manner; but as soon as a storm rises, or any thing gives them disturbance, they draw in their legs, and take in as much water as makes them somewhat heavier than the sea-water in which they swim, and they then sink to the bottom. The manner of their voiding this abundant water, when they would rise again, is by a number of holes, of which their legs are full. 2. The cymbium, with a blunt plaited carina. This species is very small, and is found in the Mediterranean.

See Plate LVIII.

ARGONAUTIC, something belonging to the Argonauts.

The argonautic expedition is one of the greatest epochas or periods of history which Sir Isaac Newton endeavours to settle, and from thence to rectify the ancient chronology. This he shows, by several authorities, to have been one generation or about thirty years earlier than the taking of Troy, and 43 years later than the death of Solomon. See CHRONOLOGY.

Dr Bryant, however, rejects the history of the Argonautic expedition as a Grecian fable, founded indeed on a tradition derived from Egypt, and ultimately referring to Noah's preservation, &c. in the ark. But although we are not to believe all the romantic stories which poets, and even some grave historians, have told us of those famous adventurers, yet it seems unreasonable to discredit enterely the Argonautic expedition. See ARGONAUTS.

ARGONAUTICA, in literary history, denotes poems on the subject and expeditions of the Argonauts. We have the *Argonautics* of Orpheus in epic verse, published by H. Stephens; the *Argonauticon* of Valerius Flaccus, in eight books of Latin heroics, in imitation of Apollonius, with respect to which Burman observes that the imitator has often surpassed the original; the *Argonautics* of Apollonius Rhodius, an heroic poem, consisting of four books, *opus*, as Quintilian calls it, *non contemnendum*.

ARGONAUTS, in antiquity, a company of illustrious Greeks, who embarked along with Jason, in the ship Argo, from Colchis, with a design to obtain the golden fleece.

The occasion of this expedition is thus represented by Greek writers. Phryxus, flying with his sister Helle from the rage of their step-mother Ino, the daughter of Cadmus, went on board a ship, whose ensign was a golden ram and sailed to Colchis (now Mingrelia, part of Georgia). Helle was drowned by the way, in that sea which from her was called the *Hellespont*, now the *Dardanelles*. This, according to some, was the ground of the poetical fable, that a ram with a golden fleece swam away with them to Colchis; and that the Argonauts undertook their famed expedition, in order to find that fleece. But Strabo and Arrian inform us, that it was a practice of the Colchians to collect gold on mount Caucassus by extending fleeces across the beds of the torrents; and as the water passed, the metallic particles remained entangled in the wool: hence, according to those historians, the adventure was named the *expedition of the golden fleece*. Sir Isaac Newtown thinks that this expedition was really an embassy sent by the Greeks, during the intestine divisions of Egypt in the reign of Amenophis, to persuade the nations upon the coast of the Euxine and Mediterranean seas, to take that opportunity of shaking off the yoke of Egypt, which Sesostris had laid upon them; and that fetching the golden fleece, was only a pretence to cover their true design.

But the most judicious and satisfactory account of the Argonautic expedition seems to be that given by Dr Gillies in his history of Greece. "The northern districts of Thessaly being peculiarly exposed to the dangerous fury of invaders, the petty princes of that province entered into a confederacy for their mutual defence. They assembled in spring and autumn at Thermopylæ, a place afterwards so illustrious, and then governed by Amphictyon, a descendant of Deucalion, whose name is immortalized in the Amphictyonic council. The advantages which the confederates derived from this measure, were soon perceived by their neighbours. The central states gradually acceded to their alliance; and about the middle of the fourteenth century before Christ, Acrisius king of Argos, and other princes of the Peloponnesus, were allowed to share the benefits and security of this useful association. See AMPHICTYONS.

"After this event, the Amphictyons appear to have long confined themselves to the original purpose of their institution. The states, whose measures were directed by this assembly, found sufficient occupation in defending their own territories; and near a century elapsed, before they undertook, by common consent, any distant expedition. But it was not to be expected that their restless activity could be always exhausted in defensive war. The establishment of the Amphictyons brought together the chiefs most distinguished by birth and bravery. Glory and emulation prompted them to arms, and revenge directed those arms against the barbarians. Jason, Admetus, and other chieftans of Thessaly, having equipped a small fleet in the neighbouring harbour of Ioleus, and particularly the ship Argo, of superior size and construction to any before known, were animated with a desire to visit foreign lands, to plant colonies in those parts of them that appeared most delightful, and to retort on their inhabitants the injuries which Greece had suffered from strangers. The princes of the north having proclaimed this spirited design over the central and southern provinces, the standard of enterprize and glory was speedily surrounded by the flower of the Grecian youth, who eagerly embraced this honourable opportunity to signalize their manly valour. Peleus, Tydeus, Telamon, and in general the fathers of those heroic chiefs who in the succeeding age shone with distinguished lustre in the plains of Troy, are numbered among the leaders of the Argonauts. They were accompanied by the chosen warriors, and by the venerable prophets, of their respective tribes; by an Esculapius, the admired father of the healing art; and by the divine Orpheus, whose sublime genius was worthy to celebrate the amazing series of their adventures.

"These adventures, however, have been too much adorned by the graces of poetry, to be the proper subjects of historical composition. The designs of the Argonauts are vieled under the allegorical, or at least doubtful, phrase, *of carrying off the golden fleece*; which, though easily explained, if we admit the report that the inhabitants of the eastern banks of the Euxine extended fleeces of wool, in order to collect the golden particles which were carried down by the torrents from Mount Caucasus, is yet described in such various language by ancient writers, that almost every modern who examines the subject, thinks himself intitled to offer, by way of explanation, some new conjecture of his own. But in opposition to the most approved of these conjectures, we may venture to affirm, that the voyage to Colchis was not undertaken with a view to establish extensive plans of commerce, or to search for mines of gold, far less to learn the imaginary art of converting other substances into that precious metal; all such motives supposing a degree of speculation and refinement unknown in that age to the gallant but uninstructed youth of Thessaly. The real object of the expedition may be discovered by its consequences. The Argonauts fought, conquered, and plundered; they settled a colony on the shores of the Euxine; and carried into Greece a daughter of the king of Colchis, the celebrated Medea, a princess of Egyptian extraction, whose crimes and enchantments are condemned to eternal infamy in the immortal lines of Euripides."

ARGONAUTS of St Nicholas, was the name of a military order instituted by Charles III. king of Naples, in the year 1382, for the advancement of navigation, or, as some say, merely for preserving amity among the nobles. They wore a collar of shells, inclosed in a silver crescent, whence hung a ship with this device, *Non credo tempori*, "I do not trust time." Hence these Argonaut

Argonaut knights came to be called *knights of the shell*. They received the order of St Basil, archbishop of Naples; and held their assemblies in the church of St Nicholas, their patron.

ARGOPHYLLUM, White-leaf *(Forst. Nov. Gen.)*: A genus of the monogynia order, belonging to the pentandria class of plants. The capsule is trilocular; the nectarium is pyramidal, pentagonous, and the length of the corolla. There is but one species, the netidum or glossy, a native of New Caledonia. This genus has great affinity with the ivy; but differs in the nectarium, and perhaps in the fruit.

ARGOS. an ancient name of Peloponnesus; from Argos, one of the kings, (Homer, Strabo).

Argos, the capital, and an inland town, of Argolis or Argeia. It had different surnames; as *Achaicum*, from the country, or an ancient people, (Homer); *Hippium*, from its breed of horses; and *Inachium*, from the river Inachus, which runs by, or from Inachus the founder of the kingdom, whose name was also given to the river. The Argives related, that this was one of the river-gods who adjudged the country to Juno, when she contended for it with Neptune, which deity in return made their water to vanish; the reason why the Inachus flowed only after rain, and was dry in summer. The source was a spring, not copious, on a mountain in Arcadia, and the river served there as a boundary between the Argives and Mantineans.

Ancient Argos stood chiefly on a flat. The springs were near the surface; and it abounded in wells, which were said to have been invented by the daughters of Danaus. This early personage lived in the acropolis or citadel, which was named *Larissa*, and accounted moderately strong. On the ascent was a temple of Apollo on the ridge, which in the second century continued the seat of an oracle. The woman who prophesied was debarred from commerce with the male sex. A lamb was sacrificed in the night, monthly; when, on tasting of the blood, she became possessed with the divinity. Farther on was a stadium, where the Argives celebrated games in honour of Neméan Jupiter and of Juno. On the top was a temple of Jupiter, without a roof, the statue off the pedestal. In the temple of Minerva there, among other curious articles, was a wooden Jupiter, with an eye more than common, having one in the forehead. This statue, it was said, was once placed in a court of the palace of Priam, who fled as a suppliant to the altar before it, when Troy was sacked. In this city was also the brazen tower in which Danäe, being confined there by her father, was deflowered by Jupiter.

Argos retains its original name and situation, standing near the mountains which are the boundary of the plain, with Napoli and the sea in view of it. The shining houses are whitened with lime or plaster. Churches, mud-built cottages and walls, with gardens and open areas, are interspersed, and the town is of considerable extent. Above the other buildings towers a very handsome mosque shaded with solemn cypresses; and behind is a lofty hill, brown and naked, of a conical form, the summit crowned with a neglected castle. The devastations of time and war have effaced the old city. We look in vain (says Mr Chandler) for vestiges of its numerous edifices, the theatre, the gymnasium, the temples, and monuments, which it once boasted, contending even with Athens in antiquity and in favours conferred by the gods.

Argos Amphilochicum, (Thucydides, a city of Acarnania, (Scylax, Pliny); its territory Amphilochia: situate on the east side of the Sinus Ambracius, (Thucydides); distant one hundred and eighty stadia to the south-east of Ambracia, (Polybius). Also called *Argia Amphilochis*, (Mela); *Amphiloci*, and *Amphilochici*, the people, (Stephanus). The name is from Amphilochus, son of Amphiaraus; and from Argos, the name of his country, in Peloponnesus, (Thucydides).

Argos Hippium. See Argos in Peloponnesus, *supra*.

Argos Hippium, the ancient name of Arpi; but Lampe is a still more ancient; afterwards called *Argyrippa*, and *Argippa*; built by, and the residence of, Diomedes, on the Cerbalus, (Virgil); afterwards a large and populous city, (Livy): a town of Apulia; now in ruins, and the place called *Arpi*.

Argos Pelasgicum, (Homer); an appellation denoting Thessaly; so called from the Pelasgi.

Argos Portus, a port of Tuscany, (Strabo): now Porto Ferraro, in the north of the island of Elba. E. Long. 11. 30. Lat. 42. 35.

ARGUIM, an island on the coast of Africa, about sixteen miles distant from Cape Blanco, situated in W. Long. 16. 30. N. Lat. 20. 20. It is scarce two miles in length; notwithstanding which, it was a bone of contention for 87 years between the Portuguese, Dutch, English, and French; and, after a variety of fortune, has at last been totally abandoned.

This island was first discovered by the Portuguese in 1444, when a fleet bound to the East touched at Arguim, and from some little trade carried on with the natives, it was imagined that a settlement there might be of some advantage to Portugal. In consequence of this opinion, a fort was erected on the island, and the Portuguese enjoyed the peaceable possession of it till 1638. At this time the Dutch having received a minute account of the condition of the island, resolved to attack it; and accordingly landed without molestation from the garrison, which was too weak to oppose them. The Portuguese, however, defended themselves with great intrepidity, and at last surrendered upon honourable terms. The Dutch immediately set about repairing the fortifications, and securing it in the best manner they could: however, in 1665, the fort was reduced almost to an heap of rubbish by an English squadron; but as the fortifications were totally destroyed, and only a small garrison left there, it was easily retaken by the Dutch the next year. They now redoubled their diligence in strengthening the island, entering into alliance with Moorish chiefs, procuring a number of families to settle under protection of the fort, and giving extravagant prices for gums, in order to monopolize the gum-trade. By this means the gum-trade of the French Senegal company was almost entirely destroyed; upon which they fitted out a squadron, dispossessed the Dutch, and had the island finally ceded to them by the treaty of Nimeguen.

Though the Dutch now seemed to be totally expelled, they resolved not to part so easily with such a valuable settlement. Under pretence of being subjects of the Elector of Brandenburg, therefore, they erected one of the forts which had been demolished, and there maintained themselves in spite of the utmost endeavours of the French company to dispossess them. Numberless were the memorials, protests, rescripts, &c. which were published upon this occasion, till a new war in 1701 put an end to them. In 1717, however, the French company having found all their remonstrances ineffectual, fitted out a new squadron; but this armament did not arrive at Arguim before Feb. 26th, 1721. The Dutch defended themselves with such intrepidity and conduct as had almost baffled the utmost efforts of the French; but the latter having found means to draw off a Moorish chief from his allegiance, the Dutch were obliged to evacuate Arguim, and retire to Portendic, where they fortified themselves, determining to watch a favourable opportunity for recovering their settlement at Arguim. This was not long wanting, by means of the weakness of the garrison and the imprudence of Duval the French director; who having quarrelled with the Moors, was surprised, defeated, and killed by them; in consequence of which, the settlement fell again into the hands of the Dutch on the 11th of Jan. 1722. In 1723, the Dutch were attacked by another French squadron under the command of the Sieur Riguadiere. This gentleman boasted that the fort could not hold out one day; but though he prevailed so far as to get possession of the cisterns which contained the water of the besieged, he was at last shamefully repulsed, and forced to raise the siege with precipitation. The Dutch, however, did not long enjoy the possession which they had so bravely defended; for, in 1725, their fort was entirely demolished by the French under Du Casse, and has never since been rebuilt by any European nation.

ARGUMENT, in rhetoric and logic, an inference drawn from premises, the truth of which is indisputable, or at least highly probable. See LOGIC.

ARGUMENT, in matters of literature, denotes also the abridgment or heads of a book, history, comedy, chapter, &c. See SYLLABUS.

ARGUMENTATION, the act of inventing or framing arguments, of making inductions, and drawing conclusions. See INDUCTION, &c.

Argumentation, according to Cicero, is the delivering or unfolding of an argument.—The matter of argumentation is propositions; the form, their due disposition, with regard to one another, so as a conclusion may be drawn from them. See ENTHYMEME, PROPOSITION, RATIOCINATION, SORITES, SYLLOGISM, &c.

ARGUS, in fabulous history, was the son of Aristor, and had 100 eyes, 50 of which were always open. Juno made choice of him to guard Io, whom Jupiter had transformed into a white heifer; but Jupiter, pitying Io for being so closely confined, sent Mercury, who, with his flute, charmed Argus to sleep, sealed up his eyes with his caduceus, and then cut off his head; when Juno, to reward his fidelity, turned him into a peacock, and placed his eyes in his tail.

Argus-Shell, a species of porcelain-shell, beautifully variegated with spots, resembling in some measure those in a peacock's tail.

ARGUTIÆ, witty and acute sayings, which commonly signify something further than what their mere words at first sight seem to import.—Writers on rhetoric speak of divers species of argutiæ, viz.

Argutiæ ab alieno, when something is said, which seems repugnant either to the nature and property of a thing, or to common custom, the laws, &c. which yet in reality is consistent therewith; or when something is given as a reason of another, which yet is not the reason of it. For instance, *Si Caius nihil didicisset, errasset minus*: again, *Aureum hoc sæculum est, quia plurimus jam auro honos venit*.

Argutiæ ab illusione, those wherein allusion is made to some history, fable, sentence, proverb, or the like; e. gr. *Multi umbram captant & carnem amittunt.*

Argutiæ a comparatis, when two things are compared together, which yet at first sight appear very different from each other, but so as to make a pretty kind of simile or dissimile; e. gr. *Par est pauper nil cupiens principi omnia habenti.*

Argutiæ a repugnantibus, when two things meet in a subject, which yet regularly cannot be therein; or when two things are opposed to each other, yet the epithet of the one is attributed to the other; e. gr. *Dum tacent clamant.*

ARGYLE (dukes of). See CAMPBELL.

ARGYLESHIRE, or ARGATHILIA, in Scotland; which together with Perthshire and the Western Islands, is said to have constituted the ancient kingdom of the Scots, while the rest of Caledonia was subject to the Picts and Romans, comprehends Kintyre, Knapdale, Argyle proper, Cowal, and Lorn. It is bounded on the south by the Irish sea and the Frith of Clyde; on the east, by Perthshire; on the north-east, by Lochaber; and on the north-west, by several Islands. The extent of it from south to north, between the Mull of Kintyre and the point of Ardnamurchan where it joins the shire of Invernefs, is about 114 miles; and the breadth in some places, including the isles, to 70. This country, like all other parts of the Highlands, affords a very wild and horrid prospect of hills, rocks, and huge mountains, piled upon each other in a stupendous and dreadful disorder; bare, bleak, and barren to the view; or at best covered with shagged heath, which appears black and dismal to the eye, except in the summer, when it is variegated with an agreeable bloom of a purple colour. The coast of Argyle is rocky: yet indented with bays and inlets, that afford good harbours for shipping. The country is well watered by rivers, brooks, and lakes, abounding with fish; the vales and flat parts of it are cultivated for corn; the mountains feed an innumerable quantity of black cattle, which run wild among the hills in winter as well as summer; the heath and woods, of which there is a considerable number, afford shelter to deer, roebucks, and all sorts of game in great plenty: the circumambient sea, with its locks, bays, and harbours, pours forth myriads of fish; but the innate wealth of the country is dug from the bowels of the mountains in iron, copper, lead, and other metals and minerals.

Argyle is the seat of a provincial synod, consisting of five presbyteries and 49 parishes; and gives the titles of *duke* and *earl* to the noble family of Campbell, the most powerful of all the Scottish nobility. The duke of Argyle is, by hereditary right, great master of the king's household in Scotland; admiral of the Western isles; general of Denoon castle; keeper of Dunstaffnage and Carrick: and, before the jurisdictions were abolished, enjoyed other hereditary offices, which rendered

dered him too powerful as the subject of a limited monarchy. He still possesses many royalties; his vassals, even of the name of *Campbell*, are so numerous, and his influence extends so far, that he could, on occasion, bring 3000 or 4000 fighting men into the field. Argyleshire is in general peopled by this clan; and affords a great number of castles and seats belonging to gentlemen who hold of the duke, and boast themselves descended from his family.

Argyle Proper is bounded by Knapdale and Cowal on the south; Lochaber on the north; Lennox and the Grampian hills on the east; and Lorne on the west. It lies between Lochfyn and Lochow; which last is a fresh-water lake, about a mile broad, but extending 24 in length, including 12 islands, on two of which there are the castles of Enconel and Glenurquhart. This lake which gives the title of *viscount* to the duke of Argyle, issues in the river Aw, which, after a course of six or seven miles, enters Loch Ettiff; and this falls into the west sea, opposite to the isle of Mull: all these abound with excellent trout and salmon. Argyleshire sends one member to parliament.

When the projected canal shall be completed, and some villages and harbours erected, the populous county of Argyle (Mr Knox affirms) will become one of the most valuable provinces in the British empire. It abounds in black cattle, sheep, and fish, though the latter are less numerous than those on the more northern shores. Washed on both sides by the sea, deeply indented by navigable lakes and bays; having an easy communication with the fishing grounds on the North Highlands; with Glasgow, and the trading towns on the Clyde; with Ireland, Wales, Whitehaven, Liverpool, Bristol, and other marts on the west coast of England, we may easily conceive, that the period is at no great distance, when Argyleshire will become a great commercial county. To corroborate this opinion, he observes, that after a vessel gets under sail from this coast, she enters at once into the Atlantic, where she meets with no interruption till she makes the coast of America or the West-Indies. The line, therefore, which nature points out for the inhabitants, is, that of salt-making, fishing, ship-building, freights or the carrying trade; soap and glass-making, by means of the kelp upon their shores, and sand found upon Gia island, which is adapted for the latter.

ARGYRASPIDES, or ARGYROASPIDES, in antiquity, persons armed with silver bucklers, or bucklers silvered.

The argyraspides, according to Quintus Curtius, made the second corps of Alexander's army; the first was the phalanx.—According to Justin's account, lib. xii. chap. 7. Alexander having penetrated into India, and extended his empire as far as the ocean; for a monument of his glory, ordered the armour of his soldiers, and the housings of his horses, to be adorned with silver. And hence commanded them to be called *argyraspides*, from the Greek αργυρος, *silver*, and ασπις, *buckler*.

By this author it should seem, that Alexander's whole army were called *argyraspides*.—After that prince's death, the agyraspides despised all other chiefs of the army, disdaining to obey any other, having borne arms under Alexander.

ARGYRIPÆ. See *ARGOS Hippium*.

ARGYRUNTUM, a maritime town of Illyria, (Ptolemy, Pliny). Now Novigrad, a town of Dalmatia. E. Long. 17. 30. Lat. 44. 30.

ARHUSEN, a diocese of North Jutland in Denmark, to the south of Wilburg, about 60 miles in length and 30 in breadth. It contains two capital cities, called *Arhusen* and *Rander*; besides several market-towns of less note, and upwards of 300 villages. Arhusen, one of the capitals, is advantageously situated on the coast of the Baltic Sea, at the mouth of the river Guda, which runs through it; and it is surrounded with forests full of game. E. Long. 10. 0. N. Lat. 56. 10.

ARIA, one of the ancient names of Thrace, (Stephanus); that is *martial*, from the character of the people, whose country Euripides calls the residence of Mars and Sophocles his place of nativity.

ARIA, and *Ariana* (anc. geog.) whether the same or distinct countries authors are not agreed. Ptolemy has only Aria, and knows nothing about Ariana. Pliny mentions only Ariana, and says nothing about Aria; but distinguishes between the Arii and Ariani: Parthia, he says, has the Arii to the east, Carmania and the Ariani to the south; from which it is conjectured, the Ariani extended farther than the Arii, and comprised the Gedrosii and the Drangae. Arrian has only Aria and Arii, and is silent about Ariana. But Strabo gives more extensive bounds to Ariana than to Aria, without particularly defining them: only in general he says, that Ariana begins from India, and quotes Eratosthenes; according to whom, Ariana is bounded by the Indus on the east; on the south, by the Great Sea; by Paropamisus on the north, and by the mountains, quite to Portæ Caspiæ; on the west, by the same boundaries by which Parthia is separated from Media, Carmania from Paraetacene and Persia: and thus Ariana is extremely extensive.—Aria has its limits thus described by Ptolemy: On the north, some parts of Margiana and Bactriana; on the east, the Paropamisidæ; on the south, the Drangiana: and Strabo says, the Arii adjoin to the the Paropamisidæ on the west.

ARIA, called *Ariapolis*, (Strabo): Now Herat, in Chorasan, set down in an ancient map as situated on the river Arias, which probably gave name to the country Aria. Arrian calls the river *Areios*; Pliny, *Arius*; Ammian, *Arias*; now Heri, which runs by Alexandria, also called *Alexandria Arion* or *Ariorum*.

ARIADNÆA, in Grecian antiquity, two festivals at Naxos, in honour of two women named *Ariadne*. One of them being the daughter of king Minos, they had, in the solemnity dedicated to her, a shew of sorrow and mourning; and, in memory of her being left by Theseus near the time of child-birth, it was usual for a young man to lie down and counterfeit all the agonies of a woman in labour. This festival is said to be first instituted by Theseus, to atone for his ingratitude to that princess.—The other Ariadne was thought to be of a gay and sprightly temper; and therefore her festival was observed with music and other expressions of mirth and joy.

ARIADNE, daughter of Minos king of Crete. Theseus being sent to destroy the Minotaur, Ariadne was so taken with him, that, as a testimony of her love, she gave Theseus a clue of thread to guide him out of the labyrinth. Theseus, having killed the Minotaur,

notaur, carried off the Athenians he had relieved, together with Ariadne; whom, however, he afterward forsook.

ARIADNIA, in antiquity. See ARIADNÆA.

ARIANA (anc. geog.), an extensive country, comprising Paropamisus, Arachosia, Drangiana, and Gedrosia, if we suppose it to reach the sea. See ARIA.

ARIANNA, a small village six miles N. E. from the city of Tunis. Here is a beautiful range of the ancient Carthaginian aqueduct, 74 feet high, supported by columns 16 feet square, and which still increased in grandeur the nearer it approached Carthage. The stones are all diamond-cut. Near this spot several ancient mattamones, or subterraneous magazines for corn, have been discovered within these few years, capable of containing 100 bushels, strongly arched with large square stones. The Moors have already begun to demolish them, it being their custom to do so with every thing beautiful as soon as it comes to light.

ARIANO, a town of Italy, in the kingdom of Naples, in the Ulterior Principality, with a bishop's see. Mr Swinburne describes it as an ugly city, built upon the uneven summit of a mountain, with an extensive look-out on all sides, but exposed to every blast that blows. It does not appear to be so old as the time of the Romans; therefore supposed to owe its rise to the demolition of some neighbouring town, and to the advantages its situation afforded for discovery and defence. It is but a poor place, without trade or manufactures; having declined ever since the desolation caused by an earthquake in 1456. It reckons about 14,000 inhabitants, and no less than 20 parishes and convents, besides an ill-endowed cathedral. The wine made here is pale, like red Champagne, which it also resembles in a certain tartness, exceedingly refreshing in hot weather. The soil lies upon a soft agrillaceous stone. At a small distance to the east is a bank consisting of layers of volcanical earths, interspersed with thick strata of oyster-shells.

Below the town is a convent of Dominicans, whose house, within these last hundred years, has been thrice rebuilt, having been as often thrown to the ground by earthquakes. The last and most destructive happened in 1732, fatal to all the country that lies along the eastern verge of the Appenine. In order to secure a retreat in case of future accidents, which from their situation they have every reason to expect, these fathers have constructed a small building of wood, the parts of which being joined together with strong iron chains, are contrived so as to have a proper play, and by yielding to the oscillatory motion of the earth, return easily to their equilibrium. E. Long. 15. 19. N. Lat. 41. 8.

ARIANS, followers of Arius, a presbyter of the church of Alexandria about the year 315; who maintained, that the Son of God was totally and essentially distinct from the Father; that he was the first and noblest of those beings whom God had created, the instrument by whose subordinate operation he formed the universe; and therefore inferior to the father both in nature and dignity: also, that the Holy Ghost was not God, but created by the power of the Son.

The Arians owned that the Son was the word, but denied that word to have been eternal. They held, that Christ had nothing of man in him but the flesh, to which the λογος or Word was joined, which was the same as the soul in us. See *Lardner's Credibility*, &c. Vol. IX. b. i. c. 69.

The Arians were first condemned and anathematized by a council at Alexandria in 320, under Alexander, bishop of that city; who accused Arius of impiety, and caused him to be expelled from the communion of the church: and afterwards by 380 fathers in the general council of Nice, assembled by Constantine in the year 325. But notwithstanding that, it was not extinguished; on the contrary, it became the reigning religion, especially in the East, where it obtained much more than in the West. Arius was recalled from banishment by the emperor Constantine in two or three years after the council of Nice, and the laws that had been enacted against him were repealed. In the year 335, Athanasius, his zealous opponent, was deposed and banished into Gaul, and Arius and his followers were reinstated in their privileges, and received into the communion of the church. In little more than a year after this, he fell a victim to the resentment of his enemies, and died a tragical death, occasioned probably by poison, or some other violence. The Arian party found a protector in Constantinus, who succeeded his father in the empire of the East; and the zeal with which he abetted them produced many animosities and tumults to the time of his death in the year 362. They underwent various revolutions, persecuting and oppressed, under succeeding emperors, according to the degree of interest they had in the civil power, till at length Theodosius the Great exerted every possible effort to suppress and disperse them.

The Arians were divided into various sects, of which ancient writers give an account under the names of *Semi-Arians*, *Eusebeans*, *Aetians*, *Eunomians*, *Acacians*, *Psathyrians*, and others. But they have been commonly distributed into three classes, viz. the *Genuine Arians*, *Semi-Arians*, and *Eunomians*.

Arianism was carried in the fifth century into Africa under the Vandals; and into Asia under the Goths: Italy, the Gauls, and Spain, were also deeply infected with it; and towards the commencement of the sixth century, it was triumphant in many parts of Asia, Africa, and Europe. But it sunk almost all at once, when the Vandals were driven out of Africa, and the Goths out of Italy, by the arms of Justinian. However, it revived again in Italy under the protection of the Lombards in the seventh century.

Erasmus seems to have aimed in some measure to restore Arianism at the beginning of the sixteenth century, in his Commentaries on the New Testament. Accordingly, he was reproached by his adversaries with Arian interpretations and glosses, Arian tenets, &c. To which he made little answer, save that there was no heresy more thoroughly extinct than that of the Arians: *Nulla heresis magis extincta quam Arianorum.* But the face of things was soon changed. Servetus, a Spaniard by nation, published in 1531 a little treatise against the Trinity, which once more revived the opinions of the Arians in the West. Indeed he rather showed himself a Photinian than an Arian; only that he made use of the same passages of Scripture, and the same arguments against the divinity of our Saviour, with the proper Arians.

It is true, Servetus had not, properly speaking, any difciples; but he gave occafion after his death to the forming of a new fyftem of Arianifm in Geneva, much more fubtle and artful than his own, and which did not a little perplex Calvin. From Geneva the new Arians removed to Poland, where they gained confiderable ground; but at length became Socinians.

The appellation *Arian* has been indifcriminately applied, in more modern times, to all thofe who confider Jefus Chrift as inferior and fubordinate to the Father; and whofe fentiments cannot be fuppofed to coincide exactly with thofe of the ancient Arians. Mr Whifton was one of the firft divines who revived this controverfy, in the beginning of the 16th century. He was followed by Dr. Clarke, who publifhed his famous book intitled *The Scripture Doctrine of the Trinity*, &c. In confequence of which he was reproached with the title of *Semi-Arian*. He was alfo threatened by the convocation, and combated by argument. Dr Waterland, who has been charged with verging towards Tritheifm, was one of his principal adverfaries. The hiftory of this controverfy during the prefent century may be found in a pamphlet, intitled *An account of all the confiderable books and Pamphlets that have been wrote on either fide, in the Controverfy concerning the Trinity, from the year* 1712; *in which is alfo contained an account of the Pamphlets written this laft Year, on each fide, by the Diffenters to the end of the Year* 1719. Publifhed at London, 1720.

ARICINA, in mythology, a furname of Diana; under which appellation fhe was honoured in the foreft Aricine, fo called from Aricia a princefs of the bloodroyal of Athens. Hippolytus, to whom this princefs was married, is faid to have erected a temple to Diana in this foreft, where he was concealed after his refurrection by Efculapius, and to have eftablifhed a prieft and feftivals.

ARIAS MONTANUS, a learned Spanifh divine, employed by Philip II. of Spain, to publifh another edition of the Bible, after that of Cardinal Ximenes; which he finifhed with applaufe, and died at Seville, in 1598.

ARICA, a port town of South-America, in the province of Los Charaes, in Peru. It was formerly a confiderable place: but the earthquakes, which are frequent here, have almoft entirely ruined it; for there are no more than 150 families, which are moft of them blacks, mulattoes, and Indians. Moft of the houfes are made with canes or reeds, fet upright, and bound together with cords or thongs; and as it never rains here, they are covered only with mats, which makes the place look at a diftance like a heap of ruins.

The vale of Arica is about a league wide, and fix leagues long, next the fea, and is all a barren country, except the fpot where the old town ftood, which is divided into little meadows of clover grafs and plots for fugar canes, with a few olive and cotton trees intermixt. This vale grows narrower as it runs eaftward: and a league up there is a village, where they begin to cultivate pimento or Jamaica pepper, which is planted throughout all the reft of the vale; and there are feveral farms, which produce nothing elfe, that bring in the value of 80,000 crowns yearly. The Spaniards of Peru are fo ufed to this pepper, that they drefs no provifion without it. W. Long. 70. 15. S. Lat. 18. 26.

ARICONIUM, a town of the Silures, (Antonine); now Hereford, (Camden). W. Long. 2. 42. Lat. 52. 6.

ARIDAS, a kind of taffety, manufactured in the Eaft Indies from a fhining thread which is got from certain herbs, whence they are ftyled *aridas of herbs*.

ARIDULLAM, in natural hiftory, a kind of zarnich found in the Eaft Indies. See ZARNICH.

ARIES, in zoology. See OVIS.

ARIES, the battering-ram. See *BATTERING-Ram*.

ARIES, in aftronomy, a conftellation of fixed ftars, drawn on the globe, in the figure of a ram. It is the firft of the twelve figns of the zodiac, from which a twelf part of the ecliptic takes its denomination.

ARILLUS, an improper term invented by Linnæus, and defined to be the proper exterior coat or covering of the feed, which falls off fpontaneoufly.

All feeds are not furnifhed with an arillus; in many, a dry covering, or fcarf-fkin, fupplies its place. In Jeffamy; hound's tongue, *cynogloffum*; cucumber; fraxinella, *dictamnus*; ftaff-tree, *celaftrus*; fpindletree, *euonymus*; African fpiræa, *diofma*; and the coffee-tree, *coffea*; it is very confpicuous.

In the genus hound's tongue, four of thefe arilli, or proper coats, each unfolding a fingle feed, are affixed to the ftylus; and in this circumftance, fays Linnæus, does the effence of the genus confift. In fraxinella, the arillus is common to two feeds. The ftaff-tree has its feeds only half involved with this cover.

The arillus is either *baccatus*, fucculent, and of the nature of a berry; as in the fpindle-tree, *euonymus*. *Cartilagineus*, cartilaginous, or griftly; as in the African fpiræa, *diofma*. *Coloratus*, coloured; as in the ftaff-tree. *Elafticus*, endued with elafticity, for difperfing the feeds; as is remarkable in the African fpiræa, *diofma*, and fraxinella. *Sebar*, rough and knotty; as in hound's tongue.

Although covered with an arillus or other dry coat, feeds are faid to be naked (*femina nuda*) when they are not inclofed in any fpecies of pericarpium or fruitveffel; as in the graffes, and the *labiati* or lipped flowers of Tournefort, which correfpond to the *didynamia gymnofpermia* of Linnæus. Seeds are faid to be covered (*feminu tecta*) when they are contained in a fruitveffel, whether capfule pod, or pulpy pericarpium, of the apple, berry, or cherry kind: See SEMEN). This exterior coat of the feed is, by fome former writers, ftyled *calyptra*. See CALYPTRA.

The different fkins or coverings of the feed, are adapted, fay naturalifts, for receiving the nutritive juices, and tranfmitting them within.

ARIMANIUS, the evil god of the ancient Perfians. The Perfian Magi held two principles: a good dæmon, or god, and an evil one: the firft the author of all good, and the other of all evil; the former they fuppofed to be reprefented by light, and the latter by darknefs, as their trueft fymbols. The good principle they named *Yezad* or *Yezdan*, and *Ormozd* or *Hormizda*, which the Greeks wrote *Oromafdes*; and the evil dæmon they called *Abriman*, and the Greeks *Arimanius*. Some of the Magians held both thefe principles to have been from all eternity; but this fect was reputed heterodox: the original doctrine being, that the good principle only was eternal, and the other created. —Plutarch (*De Ifide et Ofiride*, p. 369.) gives the

following

following account of the Magian traditions in relation to these gods and the introduction of evil into the world, viz. That Oromazes consisted of most pure light, and Arimanius of darkness; and that they were at war with each other: that Oromazes created six gods; the first, the author of benevolence: the second, of truth; the third, of justice, riches, and the pleasure which attends good actions; and that Arimanius made as many, who were the authors of the opposite evils or vices: that then Oromazes, triplicating himself, removed as far from the sun as the sun is from the earth, and adorned the heaven with stars, appointing the dog-star for their guardian and leader: that he also created 24 other gods, and inclosed them in an egg; but Arimanius having also made an equal number, these last perforated the egg, by which means evil and good became mixed together. However, the fatal time will come, when Arimanius, the introducer of plagues and famine, must be of necessity utterly destroyed by the former, and annihilated; then the earth being made plain and even, mankind shall live in a happy state, in the same manner, in the same political society, and using one and the same language. Theopompus writes, that, according to the Magians, the said two gods, during the space of 3000 years, alternately conquer, and are conquered; that for other 3000 years, they will wage mutual war, fight, and destroy the works of each other, till at last Hades (or the evil spirit) shall perish, and men become perfectly happy, their bodies needing no food, nor casting any shadow, i. e. being perfectly transparent.

ARIMASPI, (Pliny), a people of Sarmatia Europea, to the south of the Montes Riphæi, said by Mela to have but one eye; a fable broached by Aristeas Proconnesius, according to Herodotus.

ARIMATHEA, a town of Judea, (Evangelists); thought to be the same with *Ramatha*, 1 Sam. i. and thus in the tribe of Ephraim, (Wells).—This place is now called *Ramla*; and is in a very ruinous state, containing nothing but rubbish within its boundaries. The Aga of Gaza resides here in a Serai, the floors and walls of which are tumbling down. He maintains about one hundred horsemen, and as many Barbary soldiers, who (says Mr Volney) are lodged in an old Christian Church, the nave of which is used as a stable, and in an ancient kan, which is disputed with them by the scorpions. The adjacent country is planted with lofty olive trees, disposed in quincunces. The greatest part of them are as large as the walnut trees of France; but they are daily perishing through age, the ravages of contending factions, and even from secret mischief; for, in these countries, when a peasant would revenge himself of his enemy, he comes by night, and saws or cuts his trees close to the ground, and the wound, which he takes care to cover, draining of the sap like an issue, the olive tree languishes and dies. Amid these plantations, we meet, at every step, with dry wells, cisterns fallen in, and vast vaulted reservoirs, which prove that, in ancient times, this town must have been upwards of a league and a half in circumference. At present it scarcely contains two hundred families. The little land which is cultivated, by a few of them, belongs to the Mufti, and two or three persons related to him. The rest content themselves with spinning cotton, which is chiefly purchased by two French houses established there. The only remarkable antiquity at Ramla is the minoret of a ruined mosque on the road to Yafa, which is very lofty; and by an Arabic inscription appears to have been built by the sultan Saladin.

ARIMINUM, a town of Umbria, or Romagna, at the mouth of the Ariminus, on the Gulph of Venice. The seizing on it by Cæsar gave rise to the civil war. Now called *Rimini*, E. Long. 13. 30. Lat. 44. 8.

ARIOLI, in antiquity, a kind of prophets, or religious conjurers, who by abominable prayers, and horrible sacrifices at the altars of idols, procured answers to their questions concerning future events. *Isid. Orig.* lib. viii. cap. 9. These are also called *harioli*, and their operation *hariolation*. Sometimes they were denominated *aruspices* or *haruspices*. The *arioli* were distinguished by a slovenly dress, disorderly and matted beards, hair, &c.

ARION, an excellent musician and poet, inventor of dithyrambics. Periander entertained him at his court, where getting an estate, and returning to Corinth, the sailors, for lucre of his money, threw him into the sea; when, according to the poets, a dolphin, charmed with his music, took him on her back and carried him safe to shore.

ARION, an admirable horse, much more famous in poetic history than Bucephalus in that of Alexander. Authors speak variously of his origin, though they agree in giving him a divine one His production is most commonly ascribed to Neptune. This god, according to some, raised him out of the ground by a stroke of his trident: according to others, he begot him upon the body of the fury Erynnys; according to others, upon that of Ceres, whom he ravished in the form of a horse, she having previously assumed the form of a mare to elude his pursuit. This horse was nursed by the Nereids; and being sometimes yoked with the sea-horses of Neptune to the chariot of this god, he drew him with incredible swiftness through the sea. He had this singularity in him, that his right feet resembled those of a man. Neptune gave him to Capreus king of Haliartus. Capreus made a present of him to Hercules; who mounted him when he took the city of Elis, gained the prize with him in the race against Cygnus the son of Mars near Træcena, and at last made a present of him to Adrastus. It is under this last master that Arion has signalized himself the most: he won the prize for racing at the Memean games, which the princes who went to besiege Thebes instituted in the honour of Archemorus; and was the cause that Adrastus did not perish in this famous expedition, as all the other chiefs did.

ARIOSTO (Lodovico), the famous Italian poet, and author of Orlando Furioso, was born at the castle of Reggio in Lombardy in 1474. His father, who was major-domo to Duke Hercules, lived to the extent of his fortune, so left but little at his death. Ariosto, from his childhood shewed great marks of genius, especially in poetry; and wrote a comedy in verse on the story of Pyramus and Thisbe, which his brothers and sisters played. His father being utterly unlearned, and rather regarding profit than his son's inclination, compelled him to study the civil law in which having plodded some years to no purpose, he quitted it for more pleasing studies; yet often lamented, as Ovid

Ariosto. *See his Latin Poem. *Ad Patrem.*

and Petrarch did before him, and our own Milton since*, that his father banished him from the muses. At the age of 24, Ariosto lost his father, and found himself perplexed with family-affairs. However, in about six years he was, for his good parts, taken into the service of Don Hippolito, cardinal of Este. At this time he had written nothing but a few sonnets; but now he resolved to make a poem, and chose Bayardo's *Orlando Inamorato* for a ground-work. However, he was prevented writing for a great many years, and was chosen as a fit person to go on an embassy to Pope Julio II. where he gave such satisfaction, that he was sent again, underwent many dangers and difficulties, and at his return was highly favoured. Then, at his leisure, he again applied himself to his poem: but, soon after, he incurred the cardinal's displeasure for refusing to accompany him into Hungary; by which he was so discouraged, that he deferred writing for 14 years, even till the cardinal's death. After that, he finished by degrees, in great perfection, that which he began with great expectation. Duke Astolfo offered him great promotions if he would serve him; but, preferring liberty to grandeur, he refused this and other great offers from princes and cardinals, particularly from Leo X. from all whom he received notwithstanding great presents. The Duke of Ferrara delighted so much in his comedies, of which he wrote five, that he built a stage on purpose to have them played in his court, and enabled our poet to build himself a house in Ferrara, with a pleasant garden, where he used to compose his poems, which were highly esteemed by all the princes of Italy, who sent him many presents; but he said, "he would not sell his liberty for the best cardinal's hat in Rome." It was but a small, though convenient house: being asked, why he had not built it in a more magnificent manner, since he had given such noble descriptions of sumptuous palaces, beautiful porticos, and pleasant fountains, in his Orlando Furioso? He replied, That words were cheaper laid together than stones. Upon the door was the following inscription:

Parva sed apta mihi, sed nulli obnoxia, sed non
Sordida, parta meo sed tamen ære, domus.

Which Mr Harrington thus translates:

This house is small, but fit for me, but hurtful unto none;
But yet not sluttish, as you see, yet paid for with mine own.

In his diet he was temperate, and so careless of dainties, that he was fit to have lived in the world when they fed upon acorns. Whether he was ever married, is uncertain. He kept company with one Alexandria, to whom, it was reported, he was married privately, and a lady Genevera, whom he slily mentions in the 24th book of his Orlando, as poets are apt to intermix with their fictions some real amours of their own. He was urged to go ambassador to pope Clement, but would by no means accept this embassy. He translated the *Menecmi* of Plautus: and all his own comedies were so esteemed, that they were frequently acted by persons of the first quality; and when his Lena was first represented, Ferdinand of Este, afterwards Marquis of Massa, so far honoured the piece as to speak the prologue. He began one of his comedies in his father's lifetime, when the following incident shows the remarkable talent he had for poetry. His father one day rebuked him sharply, charging him with some great fault; but all the while he returned him no answer. Soon after, his brother began on the same subject; but he easily refuted him, and, with strong arguments, justified his own behaviour. "Why then (said his brother) did you not satisfy my father?" "In truth (said Ludovico), I was thinking of a part in my comedy; and methought my father's speech to me was so suited to the part of an old man's chiding his son, that I forgot I was concerned in it myself, and considered it only to make it a part of my play." It is also reported of Ariosto, that, coming by a potter's shop, he heard him singing a stave out of his Orlando, with so bad a grace, that, out of all patience, he broke with his stick several of his pots. The potter, in a pitiful tone, asking what he meant by wronging a poor man that had never injured him? "You rascal (he replied), I have not done thee half the wrong thou hast done me: for I have broken but two or three pots of thine, not worth so many halfpence; whereas thou hast broken and mangled a stanza of mine worth a mark of gold."

Ariosto was tall, of a melancholly complexion, and so absorbed in study and meditation, that he often forgot himself. His picture was drawn by Titian in a masterly manner. He was honoured with the laurel by the hands of the emperor Charles V. He was naturally affable, always assuming less than was his due, yet never putting up a known injury even from his superiors. He was so fearful on the water, that, whenever he went out of a ship, he would see others go before him; and, on land, he would alight from his horse on the least apprehension of danger. He was of an amorous disposition, and left two natural sons. He enjoyed the friendship of the most eminent men of learning of his time, most of whom he mentions with great respect in the last canto of his Orlando Furioso. His constitution was but weakly, so that he was obliged to have recourse to physicians the greatest part of his life. He bore his last sickness with great resolution and serenity; and died at Ferrara the 8th of July, 1533, according to Sir John Harrington, being then 59 years of age. He was interred in the church of the Benedictine monks, who, contrary to their custom, attended his funeral. He had a bust erected to him, and the following epitaph, written by himself, inscribed upon his tomb:

Ludovici Ariosti humantur ossa
Sub hoc marmore, seu sub hac humo, seu
Sub quidquid voluit benignus hæres,
Sive hærede benignior comes, seu
Opportunius incidens viator:
Nam scire haud potuit futura: sed nec
Tanti erat, vacuam sibi cadaver
Ut urnam cuperet parare.
Vivens ista tamen sibi paravit,
Quæ scribi voluit suo sepulchro,
Olim si quod haberet id sepulchrum:
Ne cum spiritus hoc brevi peracto
Præscripto spatio misellos artus,
Quos ægre ante reliquerat, reposcet,
Hac et hac cinerem huc et huc revellem
Dum noscat proprium, diu vagetur.

Ariosto, Aripo.

ARIPO, a strong town of Asia, on the western coast of the island of Ceylon, at the mouth of the river Sarunda. It belongs to the Dutch; and to the east of of it is a bank, where they fish for pearls. E. Long. 80. 25. N. Lat. 8. 42.

ARISBA (anc. geog.), a town of the island of Lesbos (Herodot.)—Another of Troas on the continent, in the territory and to the south-east of Abydos (Polyb.): the rendezvous of Alexander's army after the passage of the Hellespont (Arrian); a colony of the Mitylenians (Stephanus); taken and plundered by Achilles (Virgil). The residence of Axylus, celebrated by Homer, for his hospitality, which gained him the character of a friend to mankind.

ARISH, a Persian long measure, containing about 38 English inches.

ARISI, the Indian name for the plant which produces the rice. See ORYZA.

ARISTA, or AWN, among botanists, a long needle-like beard, which stands out from the husk of a grain of corn, grass, &c.

ARISTÆUS, son of Apollo and Cyrene, whom, for the many services he had rendered to mankind by his knowledge of all profitable arts, the gods placed amongst the stars; so that he is the Aquarius in the zodiac. The resemblance of his history to that of Moses has been curiously discussed by Huetius.

ARISTANDER, a famous soothsayer under Alexander the Great, over whom he gained a wonderful influence by the good success of his art. He had already had the same employment at the court of king Philip; and it was he who explained better than his brethren the dream that this Prince had after having married Olympias.

ARISTARCHUS, a Grecian Philosopher of Samos, one of the first that maintained that the earth turns upon its own centre. We are not sure of the age in which he lived; and have none of his works but a *Treatise of the greatness and distance of the Sun and Moon*, translated into Latin by Frederic Commandine, and published with Pappus's explanations in 1572.

ARISTARCHUS, a celebrated grammarian, much esteemed by Ptolemy Philometor, who committed to him the education of his son. He applied himself chiefly to criticism, and made a revisal of Homer's poems, but in too magisterial a way; for such verses as he did not like he treated as spurious. He commented on other poets; Cicero and Horace made use his name to express a very rigid critic.

ARISTIDA, in botany: A genus of the triandria digynia class; and, in the natural method, ranking under the 4th order, *Gramina*. The calyx has a double valve; the corolla has one valve, and three awns at the points. There are three species of Aristida, viz. the adscensionis, a native of the island of Ascension; the Americana, a native of Jamaica; and the plumosa, a native of America.

ARISTIDES, surnamed the *Just*, flourished at Athens at the same time with Themistocles, who triumphed over him by his boisterous eloquence, and got him banished, 483 years before Christ (See OSTRACISM): but Aristides being recalled a short time after, would never join with the enemies of Themistocles to get him banished; for nothing could make him deviate from the strictest rules of moderation and justice. Aristides brought the Greeks to unite against the Persians; distinguished himself at the famous battle of Marathon, and that of Salamine and Platea; and established an annual income of 460 talents for a fund to supply the expences of war. This great man died so poor, though he had the management of the revenues of Greece, that the state was obliged to pay his funeral expences, to give fortunes to his daughters in marriage, and a maintenance to his son Lysimachus.

ARISTIDES of Miletus, a famous Greek author, often cited by the ancients.

ARISTIDES, a very eloquent Athenian orator, who became a convert to the Christian religion, and about the year 124 presented to the emperor Adrian an apology for the Christians.

ARISTIDES (Ælius), a celebrated orator, born in Mysia, about 129 years before the Christian æra. The best edition of his works is that of Oxford, printed in Greek and Latin, in two volumes quarto.

ARISTIDES, a painter cotemporary with Apelles, flourished at Thebes about the 122d Olympiad. He was the first, according to Pliny, who expressed character and passion, the human mind, and its several emotions; but he was not remarkable for softness of colouring. "His most celebrated picture was of an infant (on the taking of a town) at the mother's breast, who is wounded and expiring. The sensations of the mother were clearly marked, and her fear lest the child, upon failure of the milk, should suck her blood." "Alexander the Great (continues the same author) took this picture with him to Pella."

Junius (in his Treatise *de Picturâ Veterum*(conjectures that the following beautiful epigram of Emilianus was written on this exquisite picture:

Ελκε, ταλαν παρα μητρος ον ουκ ετι μαζον αμελξεις
Ελκυσον υςατιον ναμα κατα φθιμενης.
Η δη γαρ ξιφεεσσι λιποπνοος αλλα τα μητρος
Φιλτρα και εν αιδη παιδοκομειν εμαθον

Elegantly translated thus;

Suck, little wretch, while yet thy mother lives,
Suck the last drop her fainting bosom gives!
She dies! her tenderness survives her breath,
And her fond love is provident in death..

Webb's Inquiry, dial. vii. p. 161.

ARISTIPPUS, the founder of the Cyrenaic sect of philosophy, was the son of Aretades, and born at Cyrene in Libya. He flourished about the 96th Olympiad. The great reputation of Socrates induced him to leave his own country, and remove to Athens, that he might have the satisfaction of hearing his discourses. He was chiefly delighted with those discourses of Socrates that related the most to pleasure: which he asserted to be the ultimate end in which all happiness consists. His manner of life was agreeable to his opinion; for he indulged himself extremely in all the luxuries of dress, wine, and women. Though he had a good estate, and three country seats, yet he was the only one of the disciples of Socrates who took money for teaching; which being observed by the philosopher, he asked Aristippus, How he came to have so much? Who in reply asked him, How he came to have so little? Upon his leaving Socrates, he went to Ægina, as Athenæus informs us, where he lived with more freedom and luxury than before. Socrates sent frequent exhortations to him, in order to reclaim him; but all in vain: and with the same view he published that discourse

course which we find in Xenophon. Here Aristippus became acquainted with Lais, the famous courtezan of Corinth; for whose sake he took a voyage to that city. He continued at Ægina till the death of Socrates, as appears from Plato's *Phædo*, and the epistle which he wrote upon that occasion. He returned at last into his own country Cyrene, where he professed philosophy, and instituted a sect, which, as we observed above, was called the *Cyrenaic*, from the place, and by some writers the *Hedonic* or voluptuous, from its doctrines. During the height of the grandeur of Dionysius the Sicilian tyrant, a great many philosophers resorted to him; and among the rest Aristippus, who was tempted thither by the magnificence of that court. Dionysius asking him the reason of his coming, he replied, "That it was in order to give what he had, and to receive what he had not:" or, as others represent it, "That when he wanted wisdom, he went to Socrates; but now as he wanted money, he was come to him." He very soon insinuated himself into the favour of Dionysius; for, being a man of a soft easy temper, he conformed himself exactly to every place, time, and person, and was a complete master of the most refined complaisance.

We have several remarkable passages concerning him during his residence at that court mentioned by Diogenes Laertius. Dionysius, at a feast, commanded that all should put on womens purple habits, and dance in them. But Plato refused, repeating these lines:

> I cannot in this gay effeminate dress
> Disgrace my manhood, or my sex betray.

But Aristippus readily submitted to the command, and made this reply immediately:

> ——At feasts, where mirth is free,
> A sober mind can never be corrupted.

At another time, interceding with Dionysius in behalf of a friend, but not prevailing, he cast himself at his feet; being reproved by one for that excess of humility, he replied, "That it was not he who was the cause of that submission; but Dionysius, whose ears were in his feet." Dionysius shewed him three beautiful courtezans, and ordered him to take his choice. Upon which he took them all three away with him, alleging that Paris was punished for preferring one to the other two: but when he had brought them to his door, he dismissed them, in order to shew that he could either enjoy or reject with the same indifference. Having desired money of Dionysius, the latter observed to him, that he had assured him a wise man wanted nothing. "Give me (says he) what I ask, and we will talk of that afterwards." When Dionysius had given it him, "Now (says he), you see I do not want." By this complaisance he gained so much upon Dionysius, that he had a greater regard for him than for all the rest of the philosophers, though he sometimes spoke with such freedom to that king, that he incurred his displeasure. When Dionysius asked, Why philosophers haunted the gates of rich men, but not rich men those of philosophers? he replied, "Because the latter know what they want, and the others not." Another time, Dionysius repeating (out of Sophocles, as Plutarch affirms, who ascribes this to Zeno) these verses:

> He that with tyrants seeks for bare support,
> Enslaves himself, though free he came to court;

he immediately answered,

> He is no slave if he be free to come.

Diocles, as Laertius informs us, related this in his *Lives of the Philosophers*; though others ascribe this saying to Plato. Aristippus had a contest with Antisthenes the Cynic philosopher; notwithstanding which, he was very ready to employ his interest at court for some friends of Antisthenes, to preserve them from death, as we find by a letter of his to that philosopher. Diogenes followed the example of his master Antisthenes in ridiculing Aristippus, and called him the *court-spaniel*.

We have many apohthegms of his preserved. Suidas observes, that he surpassed all the philosophers in the acuteness of his apohthegms. Being once railed at, he left the room; and the person who abused him, following him, and asking him why he went away, he answered, "Because it is in your power to rail, but it is not in my power not to hear you." A person observing, that the philosophers frequented the houses of rich men: "Why (says he), the physicians frequent the chambers of the sick, yet that is no reason why a man should rather choose to lie sick than be cured." To one who boasted of his great reading, he said, "That as they who feed and exercise most are not always more healthy than any who only eat and exercise to satisfy nature; so neither they who read much, but they who read no more than is useful, are truly learned." Among other instructions which he gave to his daughter Arete, he advised her particularly to despise superfluity. To one who asked him what his son would be the better for being a scholar? "If for nothing else (said he), yet for this alone, that when he comes into the theatre, one stone will not sit upon another." When a certain person recommended his son to him, he demanded 500 drachmas; and upon the father's replying, that he could buy a slave for that sum, "Do so (said he), and then you'll be master of a couple." Being reproached, because, having a suit of law depending, he fee'd a lawyer to plead for him, "Just so (said he), when I have a great supper to make, I always hire a cook." Being asked what was the difference between a wise man and a fool, he replied, "Send both of them together naked to those who are acquainted with neither of them, and then you'll know." Being reproved by a certain person (who, according to Mr Stanley, was Plato) for his costly and voluptuous feasts, "I warrant you (said he), that you would not have bestowed three farthings upon such a dinner;" which the other confessing, "Why, then (said he), I find myself less indulgent to my palate than you are to your covetous humour;" or, as it is otherwise represented, "I find, that I love my belly, and you love your money." When Simus, treasurer to Dionysius, shewed him his house magnificently furnished, and paved with costly marble, (for he was a Phrygian, and consequently profuse); Aristippus spit in his face: upon which the other growing angry, "Why, truly (said he), I could not find a fitter place." His servant carrying after him a great weight of money, and being ready to sink upon the road under his burden, he bid him throw away all that was too much for him to carry. Horace mentions this fact in his third satire of the second book:

> ——————Quid simile isti
> Græcus Aristippus? qui servos projicere aurum
> In media jussit Libya, quia tardius irent
> Propter onus segnes.

Being asked, what things were most proper for children to be instructed in? he answered, "Those which might prove of the greatest advantage to them when they came to be men." Being reproached for going from Socrates to Dionysius, he replied, "That he went to Socrates when he wanted serious instruction, and to Dionysius for diversion." Having received money of Dionysius at the same time that Plato accepted a book only, and being reproached for it, "The reason is plain (says he), I want money, and Plato wants books." Having lost a considerable farm, he said to one who seemed excessively to compassionate his loss, "You have but one field; I have three left: why should not I rather grieve for you?" Plutarch, who relates this in his book *De Tranquillitate Animi*, observes upon it, that it is very absurd to lament for what is lost, and not to rejoice for what is left. When a person told him, "That the land for his sake was lost," he replied, "That it was better so, than that he should be lost for the land." Being cast by shipwreck ashore on the island of Rhodes, and perceiving mathematical schemes and diagrams drawn upon the ground, he said, "Courage, friends; for I see the footsteps of men."

After he had lived a long time with Dionysius, his daughter Arete sent to him, to desire his presence at Cyrene, in order to take care of her affairs, since she was in danger of being oppressed by the magistrates. But he fell sick in his return home, and died at Lipara, an Æolian island. With regard to his principal opinions; like Socrates, he rejected the sciences as they were then taught, and pretended that logic alone was sufficient to teach truth and fix its bounds. He asserted, that pleasure and pain were the criterions by which we were to be determined; that these alone made up all our passions; that the first produced all the soft emotions, and the latter all the violent ones. The assemblage of all pleasure, he asserted, made true happiness, and that the best way to attain this was to enjoy the present moments. He wrote a great many books: particularly the history of Libya, dedicated to Dionysius; several Dialogues; and four books Of the Luxury of the Ancients. There are four epistles of his extant in the Socratic Collection published by Leo Allatius.

Besides Arete his daughter, whom he educated in philosophy. Aristippus had also a son, whom he disinherited for his stupidity. Arete had a son, who was named *Aristippus* from his grandfather, and had the surname of Μητροδιδακτος from his mother's instructing him in philosophy. Among his auditors, besides his daughter Arete, we have an account of Æthiops of Ptolemias, and Antipater of Cyrene. Arete communicated the philosophy which she received from her father to her son Aristippus, who transmitted it to Theodorus *the atheist*, who instituted the sect, called *Theodorean*. Antipater communicated the philosophy of Aristippus to Epitimedes his disciple; Epitimedes to Paræbates; Paræbates to Hegesias and Anniceris; and these two last, improving it by some additions of their own, obtained the honour each of them of giving a name to the *Hegesiac* and *Annicerian* sect.

Laertius mentions two other persons of the name of Aristippus; one, who wrote the History of Arcadia; the other, a philosopher of the New Academy.

ARISTO, a Stoic philosopher, the disciple of Zeno the chief of the Stoics, flourished about 290 years before the Christian æra. He differed but little from his master Zeno. He rejected logic as of no use, and natural philosophy as being above the reach of the human understanding. It is said, that being bald, the sun burnt his head; and that this caused his death.—There is a saying of his recorded, which might render the doctrine of Aristippus less odious than it ordinarily is; (see ARISTIPPUS). He used to say, "That a philosopher might do those of his hearers a prejudice who put a wrong interpretation upon good meanings; as for example, that the school of Aristippus might send out debauchees, and that of Zeno, Cynics:" which seems to imply, that the doctrine of this philosopher never produced this effect but when it was misunderstood. He should also have added, that every teacher is therefore obliged to forbear laying down ambiguous maxims, or to prevent false glosses being put upon them.

ARISTO (Titus), a Roman lawyer, perfect master of the public and civil law, of history and antiquity. The Pandects mention some books of his, as does Aulus Gellius.—He was cotemporary with Pliny the younger, who gives him a noble character, and had a most tender friendship for him. See *Plinii Epist.* lib. i. ep. 22.

ARISTOCRACY, a form of government where the supreme power is vested in the principal persons of the state. The word is derived from αριςος, *optimus*, and κρατεω, *impero*, "I govern." The ancient writers of politics prefer the aristocratical form of government to all others. The republic of Venice is an aristocracy. Aristocracy seems to coincide with oligarchy; which, however, is more ordinarily used to signify a corruption of an aristocratical state, where the administration is in the hands of too few, or where some one or two usurp the whole power.

ARISTOGITON, a famous Athenian, who, with Armodius, killed Hipparchus tyrant of Athens, about 513 years before the Christian æra. The Athenians erected a statue to him.

ARISTOLOCHIA, BIRTHWORT: A genus of the hexandria order, belonging the the gynandria class of plants; and in the natural method ranking under the 11th order *Sarmentaceæ*. It has no calyx; the corolla consists of one entire petal; and the capsule, which is below the flower, has six cells. The species are 21; but only the five following merit description. 1. The rotunda, is a native of the south of France, of Spain, and Italy, from whence the roots are brought for medicinal use. The roots are roundish, grow to the size of small turnips, being in shape and colour like the roots of cyclamens, which are frequently sold instead of them. This sort hath three or four weak trailing branches, which lie on the ground when they are not supported, and extend two feet in length; the leaves are heart-shaped and rounded at their extremity; the flowers

Aristolochia. flowers come out singly at every leaf, toward the upper part of the stalk. They are of a purplish black colour; and are frequently succeeded by oval seed-vessels having six cells full of flat seeds. 2. The longa, is a native of the same countries. This species hath long tap-roots like carrots; the branches are weak and trailing, extending little more than a foot; the flowers come out from the wings of the leaves like the other, are of a pale purple colour, and are frequently succeeded by seed-vessels like the other. 3. The serpentaria, is a native of Virginia and Carolina, from whence the *radix serpentariæ*, or snake-root, so much used in medicine, is brought over. The plant rises out of the ground in one, two, and sometimes three pliant stalks, which at every little distance are crooked or undulated. The leaves stand alternately, and are about three inches long, in form somewhat like the smilax aspera. The leaves grow close to the ground on footstalks an inch long, of a singular shape, and of a dark purple colour. A round canulated capsule succeeds the flower. It is filled with seeds, which are ripe in May. The usual price of the root when dried is 6d. per pound, both in Virginia and Carolina, which is money hardly earned; yet the negro slaves employ great part of the time allowed them by their masters in search for it, which is the reason that there are seldom found any but very small plants of this species. When they are planted in gardens in those countries where they are natives, the plants increase so much in two years time, that the hand can scarce grasp the stalks of a single one. This species delights in woods, and is usually found near the roots of great trees. 4. The indica, or contrayerva of Jamaica, is a native of that island, where its roots are used instead of the true contrayerva. It hath long trailing branches, which climb upon the neighbouring plants, and sometimes rise to a considerable height. The flowers are produced in small clusters towards the upper part of the stalks, which are of a dark purple colour. 5. The clematitis, with heart-shaped leaves, an upright stem, with the flowers crouded in the axillæ. The root is long and slender.

Culture. The first, second, and third sorts are propagated from seeds, which should be sown in the autumn, in pots filled with light fresh earth, and placed under a frame to preserve them from the frost. If they are plunged into a gentle hot-bed in the month of March, the plants will come up the sooner. In summer, and in autumn when the stalks begin to decay, they must be watered. In winter they must be again sheltered; and in March, before the roots begin to shoot, they must be transplanted into small separate pots filled with light earth, when they may be removed into the open air, and treated as before. The next spring they may be planted in the open air in a warm border; where, in the autumn, when their stalks decay, if the border is covered with old tanner's bark to keep out the frost, the roots will be secured; but where this care is not taken, they will frequently be killed by the frost. The fourth is tender: and therefore must be kept in a stove during the winter, or it will not live in England.

Medical Uses. The roots of the long and round sorts, on being first chewed, scarce discover any taste, but in a little time prove nauseously bitterish; the long somewhat the least so. The root of the clematitis is long and slender, rarely exceeding the thickness of a goose-quill: it instantly fills the mouth with an aromatic bitterness, which is not ungrateful. Their medical virtues are, to heat, stimulate, attenuate viscid phlegm, and promote the fluid secretions in general: they are principally celebrated in suppressions of female evacuations. The dose in substance is from a scruple to two drams. The long sort is recommended externally for cleansing and drying wounds and ulcers, and in cutaneous diseases.

Aristomenes. Aristophanes.

The root of the serpentaria is small, light, bushy, and consists of a number of strings or fibres, matted together, issuing from one common head; of a brownish colour on the outside, and paler or yellowish within. It has an aromatic smell, like that of valerian, but more agreeable: and a warm, bitterish, pungent taste. This root is a warm diaphoretic and diuretic; it has been greatly celebrated as an alexipharmic, and esteemed one of the principal remedies in malignant fevers and epidemic diseases. In these intentions, it is given in substance from 10 to 30 grains; and in infusion, to a dram or two. Both watery and spirituous menstrua extract its virtue by infusion, and elevate some share of its flavour in distillation; along with the water a small portion of essential oil arises.

None of these articles, however, are now in so much esteem as formerly; and while all of them are banished from the Pharmacopœia of the London college, the clematitis is alone retained in that of Edinburgh.

ARISTOMENES, a general of the Messenians, renowned for his valour and virtue. See MESSENIA.

ARISTOPHANES, a celebrated comic poet of Athens. He was cotemporary with Plato, Socrates, and Euripides; and most of his plays were written during the Peloponnesian war. His imagination was warm and lively, and his genius particularly turned to raillery. He had also great spirit and resolution; and was a declared enemy to slavery, and to all those who wanted to oppress their country. The Athenians suffered themselves in his time to be governed by men who had no other views than make themselves masters of the commonwealth. Aristophanes exposed the designs of these men, with great wit and severity, upon the stage. Cleo was the first whom he attacked, in his comedy of the *Equites*; and as there was not one of the comedians who would venture to personate a man of his great authority, Aristophanes played the character himself, and with so much success, that the Athenians obliged Cleo to pay a fine of five talents, which were given to the poet. He described the affairs of the Athenians in so exact a manner, that his comedies are a faithful history of that people. For this reason, when Dionysius king of Syracuse desired to learn the state and language of Athens, Plato sent him the comedies of Aristophanes, telling him, these were the best representations thereof. He wrote above 50 comedies; but there are only 11 extant which are perfect: these are, Plutus, the Clouds, the Frogs, Equites, the Acharnenses, the Wasps, Peace, the Birds, the Ecclesiazusæ or Female Orators, the Thesmophosiazusæ or Priestesses of Ceres, and Lysistrata. The Clouds, which he wrote in ridicule of Socrates*, is the most celebrated of all his comedies. Madam Dacier tells us, she was so much charmed with this performance, that after she had translated it, and read it over 200 times, it did not become the least tedious to her, which

* See the article *Socrates*.

which ſhe could not ſay of any other piece; and that the pleaſure which ſhe received from it was ſo exquiſite, that ſhe forgot all the contempt and indignation which Ariſtophanes deſerved for employing his wit to ruin a man, who was wiſdom itſelf, and the greateſt ornament of the city of Athens. Ariſtophanes having conceived ſome averſion to the poet Euripides, ſatirizes him in ſeveral of his plays, particularly in his Frogs and his Theſmophoſiazuſæ. He wrote his Peace in the 10th year of the Peloponneſian war, when a treaty for 50 years was concluded between the Athenians and the Lacedæmonians, though it continued but ſeven years. The Acharnenſes was written after the death of Pericles, and the loſs of the battle in Sicily, in order to diſſuade the people from intruſting the ſafety of the commonwealth to ſuch imprudent generals as Lamachus. Soon after, he repreſented his Aves or Birds; by which he admoniſhed the Athenians to fortify Decelæa, which he calls by a fictitious name *Nephelococcygia*. The Vaſpæ, or Waſps, was written after another loſs in Sicily, which the Athenians ſuffered from the miſconduct of Chares. He wrote the Lyſiſtrata when all Greece was involved in a war; in which comedy the women are introduced debating upon the affairs of the commonwealth; when they come to a reſolution, not to go to bed with their huſbands till a peace ſhould be concluded. His Plutus, and other comedies of that kind, were written after the magiſtrates had given orders that no perſon ſhould be expoſed by name upon the ſtage. He invented a peculiar kind of verſe, which was called by his name, and is mentioned by Cicero in his Brutus; and Suidas ſays, that he alſo was the inventor of the tetrameter and octameter verſe.

Ariſtophanes was greatly admired among the ancients, eſpecially for the true Attic elegance of his ſtyle. The time of his death is unknown; but it is certain he was living after the expulſion of the tyrants by Thraſybulus, whom he mentions in his Plutus and other comedies. There have been ſeveral editions and tranſlations of this poet. Nicodemus Friſchin, a German, famous for his claſſical knowledge, in the 16th century, tranſlated Plutus, the Clouds, the Frogs, the Equites, and the Acharnenſes, into Latin verſe. Quintus Septimus Florens rendered into Latin verſe the Waſps, the Peace, and Lyſiſtrata; but his tranſlation is full of obſolete words and phraſes. Madam Dacier publiſhed at Paris, in 1692, a French verſion of Plutus and the Clouds, with critical notes, and an examination of them according to the rules of the theatre. Mr Lewis Theobald likewiſe tranſlated theſe two comedies into Engliſh, and publiſhed them with remarks. The moſt noble edition of this author is that publiſhed by Ludolphus Kuſter, at Amſterdam, in folio, in 1710, and dedicated to Charles Montague Earl of Halifax.

ARISTOTELIA, in antiquity, annual feaſts celebrated by the citizens of Stagiris, in honour of Ariſtotle, who was born there; and in gratitude for his having procured from Alexander the rebuilding and repeopling of that city, which had been demoliſhed by king Philip.

ARISTOTELIAN, ſomething that relates to the philoſopher Ariſtotle.

Aristotelian Philoſophy, the philoſophy taught by Ariſtotle, and maintained by his followers. The Ariſtotelian is otherwiſe called the *Peripatetic philoſophy*. See Peripatetics.

ARISTOTELIANS, a ſect of philoſophers, otherwiſe called *Peripatetics*.

The Ariſtotelians and their dogmata prevailed for a long while in the ſchools and univerſities; even in ſpite of all the efforts of the Carteſians, Newtonians, and other corpuſcularians. But the ſyſtems of the latter, have at length gained the pre-eminence; and the Newtonian philoſophy in particular is now very generally received. The principles of Ariſtotle's philoſophy, the learned agree, are chiefly laid down in the four books *de Cœlo*; the eight books of *Phyſical Auſcultation*, φυσικης ακροασεως, belonging rather to logics, or metaphyſics, than to phyſics. Inſtead of the more ancient ſyſtems, he introduced matter, form, and privation, as the principles of all things; but he does not ſeem to have derived much benefit from them in natural philoſophy. His doctrines are, for the moſt part, ſo obſcurely expreſſed, that it has not yet been ſatisfactorily aſcertained what were his ſentiments on ſome of the moſt important ſubjects. He attempted to refute the Pythagoræan doctrine concerning the twofold motion of the earth; and pretended to demonſtrate, that the matter of the heavens is ungenerated, incorruptible, and ſubject to no alteration: and he ſuppoſed that the ſtars were carried round the earth in ſolid orbs. The reader will find a diſtinct account of the logical part of his philoſophy by Dr Reid profeſſor of moral philoſophy in the univerſity of Glaſgow, in the ſecond volume of Lord Kames's Sketches of the Hiſtory of Man; and Mr Harris has publiſhed a ſenſible commentary on his Categories, under the title of *Philoſophical Arrangements*.

ARISTOTLE, the chief of the Peripatetic philoſophers, born at Stagyra, a ſmall city in Macedon, in the 99th Olympiad, about 384 years before the birth of Chriſt. He was the ſon of Nicomachus, phyſician to Amyntas the grandfather of Alexander the Great. He loſt his parents in his infancy; and Proxenes, a friend of his father's, who had the care of his education, taking but little notice of him, he quitted his ſtudies, and gave himſelf up to the follies of youth. After he had ſpent moſt of his patrimony, he entered into the army; but not ſucceeding in this profeſſion, he went to Delphos to conſult the oracle what courſe of life he ſhould follow; when he was adviſed to go to Athens, and ſtudy philoſophy. He accordingly went thither about 18 years of age, and ſtudied under Plato till he was 37. By this time he had ſpent his whole fortune; and we are told that he got his living by ſelling powders, and ſome receipts in pharmacy. He followed his ſtudies with moſt extraordinary diligence, ſo that he ſoon ſurpaſſed all in Plato's ſchool. He eat little, and ſlept leſs; and, that he might not over-ſleep himſelf, Diogenes Laertius tells us, that he lay always with one hand out of the bed, having a ball of braſs in it, which, by its falling into a baſon of the ſame metal, awaked him. We are told, that Ariſtotle had ſeveral conferences with a learned Jew at Athens, and that by this means he inſtructed himſelf in the ſciences and religion of the Egyptians, and thereby ſaved himſelf the trouble of travelling into Egypt. When he had ſtudied about 15 years under Plato, he began

Aristotle.

to form different tenets from those of his master, who became highly picked at his behaviour. Upon the death of Plato, he quitted Athens; and retired to Atarnya, a little city in Mysia, where his old friend Hermias reigned. Here he married Pythias, the sister of this prince, whom he is said to have loved so passionately, that he offered sacrifice to her. Some time after, Hermias having been taken prisoner by Meranon the king of Persia's general, Aristotle went to Mitylene the capital of Lesbos, where he remained till Philip king of Macedon having heard of his great reputation, sent for him to be tutor to his son Alexander, then about 14 years of age: Aristotle accepted the offer; and in eight years taught him rhetoric, natural philosophy, ethics, politics, and a certain sort of philosophy, according to Plutarch, which he taught nobody else. Philip erected statues in honour of Aristotle; and for his sake rebuilt Stagyra, which had been almost ruined by the wars.

The last fourteen years of his life he spent mostly at Athens, surrounded with every assistance which men and books could afford him, for prosecuting his philosophical inquiries. The glory of Alexander's name, which then filled the world, insured tranquillity and respect to the man whom he distinguished as his friend: but after the premature death of that illustrious protector, the invidious jealousy of priests and sophists inflamed the malignant and superstitious fury of the Athenian populace; and the same odious passions which proved fatal to the offensive virtue of Socrates, fiercely assailed the fame and merit of Aristotle. To avoid the cruelty of persecution, he secretly withdrew himself to Chalcis, in Euboea. This measure was sufficiently justified by a prudent regard to his personal safety; but lest his conduct should appear unmanly, when contrasted with the firmness of Socrates in a similar situation, he condescended to apologize for his flight, by saying, that he was unwilling to afford the Athenians a second opportunity "to sin against philosophy." He seems to have survived his retreat from Athens only a few months, vexation and regret probably ended his days.

Besides his treatises on philosophy, he wrote also on poetry, rhetoric, law, &c. to the number of 400 treatises, according to Diogenes Laertius; or more, according to Francis Patricius of Venice. An account of such as are extant, and of those said to be lost, may be seen in Fabricius's *Bibliotheca Græca*. He left his writings with Theophrastus, his beloved disciple and successor in the Lycæum, and forbad that they should ever be published. Theophrastus, at his death, trusted them to Neleus, his good friend and disciple; whose heir buried them in the ground at Scepsis, a town of Troas, to secure them from the king of Pergamus, who made great search every where for books to adorn his library. Here they lay concealed 160 years, until, being almost spoiled, they were sold to one Apellicon, a rich citizen of Athens. Sylla found them at this man's house, and ordered them to be carried to Rome. They were some time after purchased by Tyrannion a grammarian; And Andronicus of Rhodes having bought them of his heirs, was in a manner the first restorer of the works of this great philosopher; for he not only repaired what had been decayed by time and ill-keeping, but also put them in a better order, and got them copied. There were many who followed the doctrine of Aristotle in the reigns of the 12 Cæsars, and their numbers increased much under Adrian and Antoninus: Alexander Aphrodinus was the first professor of the Peripatetic philosophy at Rome, being appointed by the emperors Marcus Aurelius and Lucius Verus; and in succeeding ages the doctrine of Aristotle prevailed among almost all men of letters, and many commentaries were written upon his works.

Aristotle, Aristoxenus.

The first doctors of the church disapproved of the doctrine of Aristotle, as allowing too much to reason and sense; but Anatolius bishop of Laodicea, Didymus of Alexandria, St Jerome, St Augustine, and several others, at length wrote and spoke in favour of it. In the sixth age, Boethius made him known in the west, and translated some of his pieces into Latin. But from the time of Boethius to the eighth age, Joannes Damascenus was the only man who made an abridgement of his philosophy, or wrote any thing concerning him. The Grecians, who took great pains to restore learning in the 11th and following ages, applied much to the works of this philosopher, and many learned men wrote commentaries on his writings: amongst these were Alfarabius, Algazel, Avicenna, and Averroes. They taught his doctrine in Africa, and afterwards at Cordova in Spain. The Spaniards introduced his doctrine into France, with the commentaries of Averroes and Avicenna; and it was taught in the university of Paris, until Amauri, having supported some particular tenets on the principles of this philosopher, was condemned of heresy, in a council held there in 1210, when all the works of Aristotle that could be found were burnt, and the reading of them forbidden under pain of excommunication. This prohibition was confirmed, as to the physics and metaphysics, in 1215, by the pope's legate; though at the same time he gave leave for his logic to be read, instead of St Augustine's used at that time in the university. In the year 1265, Simon, cardinal of St Cecil, and legate from the holy see, prohibited the reading of the physics and metaphysics of Aristotle. All these prohibitions, however, were taken off in 1366; for the cardinals of St Mark and St Martin, who were deputed by Pope Urban V. to reform the university of Paris, permitted the reading of those books which had been prohibited: and in the year 1448, Pope Stephen approved of all his works, and took care to have a new translation of them into Latin.

ARISTOXENUS, the most ancient musical writer, of whose works any tracts are come down to us. He was born at Tarentum, a city in that part of Italy called *Magna Græcia*, now Calabria. He was the son of a musician, whom some call *Mnesias*, others *Spintharus*. He had his first education at Mantinæa, a city of Arcadia, under his father, and Lamprus of Erythræ; he next studied under Xenophilus, the Pythagorean; and lastly under Aristotle, in company with Theophrastus. Suidas, from whom these particulars are transcribed, adds, that Aristoxenus, enraged at Aristotle having bequeathed his school to Theophrastus, traduced him ever after. But Aristocles the Peripatetic in Eusebius, exculpates Aristoxenus in this particular, and assures us that he always spoke with great respect of his master Aristotle. From the preceding account it appears that Aristoxenus lived under Alexander the Great and his first successors. His *Harmonics*

nics in three books, all that are come down to us, together with Ptolemy's Harmonic's, were first published by Gogavinus, but not very correctly, at Venice, 1562, in 4to, with a Latin version. John Meursius next translated the three books of Aristoxenus into Latin, from the MS. of Jos. Scaliger; but according to Meibomius, very negligently. With these he printed at Leyden, 1616, 4to. Nicomachus and Alypius, two other Greek writers on music. After this, Meibomius collected these musical writers together; to which he added Euclid, Bacchius senior, Aristides Quintilianus; and published the whole, with a Latin version, and notes, from the elegant press of Elzevir, Amst. 1652. The learned editor dedicates these ancient musical treatises to Christina queen of Sweden. Aristoxenus is said by Suidas to have written 452 different works, among which those on music were the most esteemed; yet his writings on other subjects are very frequently quoted by ancient authors, notwithstanding Cicero and some others say that he was a bad philosopher, and had nothing in his head but music. The titles of several of the lost works of Aristoxenus, quoted by Athenæus and others, have been collected by Meursius in his notes upon this author, by Tonsius and Menage, all which Fabricius has digested into alphabetical order.

ARITHMETIC

IS a science which explains the properties of numbers, and shows the method or art of computing by them.

History of Arithmetic.

AT what time this science was first introduced into the world we can by no means determine. That some part of it, however, was coeval with the human race was absolutely certain. We cannot conceive how any man endowed with reason can be without some knowledge of numbers. We are indeed told of nations in America who have no word in their language to express a greater number than three; and this they call *pœtarrarorincouroac:* but that such nations should have no idea of a greater number than this, is absolutely incredible. Perhaps they may compute by threes, as we compute by tens; and this may have occasioned the notion that they have no greater number than three.

But though we cannot suppose any nation, or indeed any single person, ever to have been without some knowledge of the difference between greater and smaller numbers, it is possible that mankind may have subsisted for a considerable time without bringing this science to any perfection, or computing by any regular scale, as 10, 60, &c. That this, however, was very early introduced in the world, even before the flood, we may gather from the following expression in Enoch's prophecy, as mentioned by the apostle Jude: "Behold the Lord cometh with *ten thousands* of his saints." This shows, that even at that time men had ideas of numbers as high as we have at this day, and computed them also in the same manner, namely by tens. The directions also given to Noah concerning the dimensions of the ark, leave us no room to doubt that he had a knowledge of numbers, and of measures likewise. When Rebekah was sent away to Isaac, Abraham's son, her relations wished she might be the mother of *thousands of millions*; and if they were totally unacquainted with the rule of multiplication, it is difficult to see how such a wish could have been formed.

It is probable, therefore, that the four fundamental rules of Arithmetic have always been known to some nation or other. No doubt, as some nations, like the Europeans formerly, and the Africans and Americans now, have been immersed in the most abject and deplorable state of ignorance, they might remain for some time unacquainted with numbers, except such as they had immediate occasion for; and, when they came afterwards to improve, either from their own industry, or hints given by others, might fancy that they themselves, or those from whom they got the hints, had invented what was known long before. The Greeks were the first European nation among whom arithmetic arrived at any degree of perfection. M. Goguet is of opinion, that they first used pebbles in their calculations: a proof of which he imagines is, that the word ψηφιζω, which comes from ψηφος, a little stone, or flint, among other things, signifies *to calculate*. The same, he thinks, is probable of the Romans; and derives the word *calculation* from the use of little stones (*calculi*) in their first arithmetical operations.

If this method, however, was at all made use of, it must have been but for a short time, since we find the Greeks very early made use of the letters of the alphabet to represent their numbers. The 24 letters of their alphabet, taken according to their order, at first denoted the numbers 1, 2, 3, 4, 5, 7, 8, 9, 10, 20, 30, 40, 50, 60, 70, 80, 100, 200, 300, 400, 500, 600, 700, and 800; to which they added the three following, ς, ϟ, ϡ, to represent 6, 90, 900. The difficulty of performing arithmetical operations by such marks as these may easily be imagined, and is very conspicuous from Archimedes's treatise concerning the dimensions of a circle.

The Romans followed a like method; and besides characters for each rank of classes, They introduced others for five, fifty, and five hundred. Their method is still used for distinguishing the chapters of books, and some other purposes. Their numeral letters and values are the following:

I	V	X	L	C	D	M
One,	five,	ten,	fifty,	one hundred,	five hundred,	one thousand.

Any number, however great, may be represented by repeating and combining these according to the following rules:

1st, When the same letter is repeated twice, or oftener, its value is represented as often. Thus II signifies two: XXX thirty, CC two hundred.

2d, When a numeral letter of lesser value is placed after one of greater, their values are added: thus XI signifies

signifies eleven, LXV sixty-five, MDCXXVIII one thousand six hundred and twenty-eight.

3d. When a numeral letter of lesser value is placed before one of greater, the value of the lesser is taken from that of the greater; thus IV signifies four, XL forty, XC ninety, CD four hundred.

Sometimes Iↄ is used instead of D for 500, and the value is increased ten times by annexing ↄ to the right hand.

Thus Iↄ signifies	500. Also CIↄ is used for		1000
Iↄↄ	5000	CCIↄↄ for	10000
Iↄↄↄ	50000	CCCIↄↄↄ for	100000

Sometimes thousands are represented by drawing a line over the top of the numeral, $\overline{\text{V}}$ being used for five thousand, $\overline{\text{L}}$ for fifty thousand, $\overline{\text{CC}}$ two hundred thousand.

4 Sexagesimal Arithmetic.

About the year of Christ 200, a new kind of arithmetic, called *sexagesimal*, was invented, as is supposed, by Claudius Ptolomæus. The design of it was to remedy the difficulties of the common method, especially with regard to fractions. In this kind of arithmetic, every unit was supposed to be divided into 60 parts, and each of these into 60 others, and so on: hence any number of such parts were called *sexagesimal fractions;* and to make the computation in whole numbers more easy, he made the progression in these also sexagesimal. Thus from one to 59 were marked in the common way: then 60 was called a *sexagesima prima*, or first sexagesimal integer, and had one single dash over it; so 60 was expressed thus I'; and so on to 59 times 60, or 3540, which was thus expressed LIX'. He now proceeded to 60 times 60, which he called a *sexagesima secunda*, and was thus expressed I''. In like manner, twice 60 times 60, or 7200, was expressed by II''; and so on till he came to 60 times 3600, which was a third sexagesimal, and expressed thus, I'''. If any number less than 60 was joined with these sexagesimals, it was added in its proper characters without any dash; thus $\mathrm{I}'\mathrm{XV}$ represented 60 and 15, or 75; $\mathrm{I}'\mathrm{VXXV}$ is four times 60 and 25, or 265; $\mathrm{X}''\mathrm{II}'\mathrm{XV}$, is ten times 3600, twice 60 and 15, or 36,135, &c. Sexagesimal fractions were marked by putting the dash at the foot, or on the left hand of the letter: thus $\mathrm{I}_{,}$ or $'\mathrm{I}$, denoted $\frac{1}{60}$; $\mathrm{I}_{,,}$ or $''\mathrm{I}$, $\frac{1}{3600}$, &c.

5 Indian Characters when brought into use.

The most perfect method of notation, which we now use, came into Europe from the Arabians, by the way of Spain. The Arabs however, do not pretend to be the inventors of them, but acknowledge that they received them from the Indians. Some there are indeed, who contend that neither the Arabs nor the Indians were the inventors, but that they were found out by the Greeks. But this is by no means probable; as Maximus Planudes, who lived towards the close of the 13th century, is the first Geek who makes use of them: and he is plainly not the inventor; for Dr Wallis mentions an inscription on a chimney in the parsonage-house of Helendon in Northamptonshire, where the date is expressed by M° 133, instead of 1133. Mr Luffkin furnishes a still clearer instance of their use, in the window of a house, part of which is a Roman wall, near the market-place in Colchester; where between two carved lions stands an escutcheon with the figures 1090. Dr Wallis is of opinion that these characters must have been used in England at least as long ago as the year 1050, if not in ordinary affairs, at least in mathematical ones, and in astronomical tables. How these characters came to be originally invented by the Indians we are entirely ignorant.

The introduction of the Arabian characters in notation did not immediately put an end to the sexagesimal arithmetic. As this had been used in all the astronomical tables, it was for their sakes retained for a considerable time. The sexagesimal integers went first out, but the fractions continued till the invention of decimals.

9 Treatises on Arithmetic.

The oldest treatises extant upon the theory of arithmetic are the seventh, eighth, and ninth books of Euclid's elements, where he treats of proportion and of prime and composite numbers; both of which have received improvements since his time, especially the former. The next of whom we know any thing is Nicomachus the Pythagorean, who wrote a treatise of the theory of arithmetic, consisting chiefly of the distinctions and divisions of numbers into classes, as plain, solid, triangular, quadrangular, and the rest of the figurate numbers as they are called, numbers odd and even, &c. with some of the more general properties of the several kinds. This author is, by some, said to have lived before the time of Euclid; by others, not long after. His arithmetic was published at Paris in 1538. The next remarkable writer on this subject is Boethius, who lived at Rome in the time of Theodoric the Goth. He is supposed to have copied most of his work from Nicomachus.

From this time no remarkable writer on arithmetic appeared till about the year 1200, when Jordanus of Namur wrote a treatise on this subject, which was published and demonstrated by Joannes Faber Stapulensis in the 15 century, soon after the invention of printing. The same author also wrote upon the new art of computation by the Arabic figures, and called this book *Algorismus Demonstratus*. Dr Wallis says this manuscript is in the Savillian library at Oxford, but it hath never yet been printed. As learning advanced in Europe, so did the knowledge of numbers; and the writers on arithmetic soon became innumerable. About the year 1464, Regiomontanus, in his triangular tables, divided the Radius into 10,000 parts instead of 60,000; and thus tacitly expelled the sexagesimal arithmetic. Part of it, however, still remains in the division of time, as of an hour into 60 minutes, a minute into 60 seconds, &c. Ramus in his arithmetic, written about the year 1550, and published by Lazarus Schonerus in 1586, uses decimal periods in carrying on the square and cube roots to fractions. The same had been done before by our countrymen Buckley and Record; but the first who published an express treatise on decimals was Simon Stevinius, about the year 1582. As to the circulating decimals, Dr Wallis is the first who took much notice of them. He is also the author of the *arithmetic of infinites*, which has been very usefully applied to geometry. The greatest improvement, however, which the art of computation ever received, is the invention of logarithms. The honour of this invention is unquestionably due to Lord Napier, baron of Merchiston in Scotland, about the end of the 16th or beginning

Notation and Numeration.

beginning of the 17th century. By theſe means arithmetic has advanced to a degree of perfection which the ancients could never have imagined poſſible, much leſs hoped to attain; and we believe it may now be reckoned one of thoſe few ſciences which have arrived at their utmoſt height, and which is in its nature capable of little further improvement.

7 Chap. I. NOTATION and NUMERATION.

The firſt elements of arithmetic are acquired during our infancy. The idea of one, though the ſimpleſt of any, and ſuggeſted by every ſingle object, is perhaps rather of the negative kind, and conſiſts partly in the excluſion of plurality, and is not attended to till that of a number be acquired. Two is formed by placing one object near another; three, four, and every higher number, by adding one continually to the former collection. As we thus advance from lower numbers to higher, we ſoon perceive that there is no limit to this increaſing operation; and that, whatever number of objects be collected together, more may be added, at leaſt in imagination; ſo that we can never reach the higheſt poſſible number, nor approach near it. As we are led to underſtand and add numbers by collecting objects, ſo we learn to diminiſh them by removing the objects collected; and if we remove them one by one, the number decreaſes through all the ſteps by which it advanced, till only one remain, or none at all. When a child gathers as many ſtones together as ſuits his fancy, and then throws them away, he acquires the firſt elements of the two capital operations in arithmetic. The idea of numbers, which is firſt acquired by the obſervation of ſenſible objects, is afterwards extended to meaſures of ſpace and time, affections of the mind, and other immaterial qualities.

Small numbers are moſt eaſily apprehended: a child ſoon knows what two and what three is; but has not any diſtinct notion of ſeventeen. Experience removes this difficulty in ſome degree; as we become accuſtomed to handle larger collections, we apprehend clearly the number of a dozen or a ſcore; but perhaps could hardly advance to an hundred without the aid of claſſical arrangement, which is the art of forming ſo many units into a claſs, and ſo many of theſe claſſes into one of a higher kind, and thus advancing through as many ranks of claſſes as occaſion requires. If a boy arrange an hundred ſtones in one row, he would be tired before he could reckon them; but if he place them in ten rows of ten ſtones each, he will reckon an hundred with eaſe; and if he collect ten ſuch parcels, he will reckon a thouſand. In this caſe, ten is the loweſt claſs, an hundred is a claſs of the ſecond rank, and a thouſand is a claſs of the third rank.

There does not ſeem to be any number naturally adapted for conſtituting a claſs of the loweſt, or any higher rank to the excluſion of others. However, as ten has been univerſally uſed for this purpoſe by the Hebrews, Greeks, Romans, and Arabians, and by all nations who have cultivated this ſcience, it is probably the moſt convenient for general uſe. Other ſcales, however, may be aſſumed, perhaps on ſome occaſions, with ſuperior advantage; and the principles of arithmetic will appear in their full extent, if the ſtudent can adapt them to any ſcale whatever: thus, if eight were the ſcale, 6 times 3 would be two claſſes and two units, and the number 18 would then be repreſented by 22. If 12 were the ſcale, 5 times 9 would be three claſſes and nine units, and 45 would be repreſented by 39, &c.

Numeration.

It is proper, whatever number of units conſtitutes a claſs of the lower rank, that the ſame number of each claſs ſhould make one of the next higher. This is obſerved in our arithmetic, ten being the univerſal ſcale: but is not regarded in the various kinds of monies, weights, and the like, which do not advance by any univerſal meaſure; and much of the difficulty in the practice of arithmetic ariſes from that irregularity.

As higher numbers are ſomewhat difficult to apprehend, we naturally fall on contrivances to fix them in our minds, and render them familiar: but notwithſtanding all the expedients we can fall upon, our ideas of high numbers are ſtill imperfect, and generally far ſhort of the reality; and though we can perform any computation with exactneſs, the anſwer we obtain is often incompletely apprehended.

It may not be amiſs to illuſtrate, by a few examples, the extent of numbers which are frequently named without being attended to. If a perſon employed in telling money reckon an hundred pieces in a minute, and continue at work ten hours each day, he will take ſeventeen days to reckon a million; a thouſand men would take 45 years to reckon a billion. If we ſuppoſe the whole earth to be as well peopled as Britain, and to have been ſo from the creation, and that the whole race of mankind had conſtantly ſpent their time in telling from a heap conſiſting of a quadrillion of pieces, they would hardly have yet reckoned the thouſandth part of that quantity.

All numbers are repreſented by the ten following characters.

1	2	3	4	5	6	7	8	9	0
One,	two,	three,	four,	five,	ſix,	ſeven,	eight,	nine,	cypher.

The nine firſt are called *ſignificant figures*, or *digits*; and ſometimes repreſent units, ſometimes tens, hundreds, or higher claſſes. When placed ſingly, they denote the ſimple numbers ſubjoined to the characters. When ſeveral are placed together, the firſt or right-hand figure only is to be taken for its ſimple value: the ſecond ſignifies ſo many tens, the third ſo many hundreds, and the others ſo many higher claſſes, according to the order they ſtand in. And as it may ſometimes be required to expreſs a number conſiſting of tens, hundreds, or higher claſſes, without any units or claſſes of a lower rank annexed; and as this can only be done by figures ſtanding in the ſecond, third, or higher place, while there are none to fill up the lower ones; therefore an additional character or cypher (0) is neceſſary, which has no ſignification when placed by itſelf, but ſerves to ſupply the vacant places, and bring the figures to their proper ſtation.

The following table ſhews the names and diviſions of the claſſes. 8.

8.	Trillions.
4	Hundred thousand of billions
3	Ten thousand of billions
7,	Thousand billions
9	Hundred billions
8	Ten billions
2.	Billions.
5	Hundred thousand of millions
6	Ten thousand of millions
4,	Thousand millions
7	Hundred millions
3	Ten millions
8.	Millions.
9	Hundred thousands
7	Ten thousands
2,	Thousands
6	Hundreds
4	Tens
5	Units

The first six figures from the right hand are called the *unit period*, the next six the *million period*, after which the *trillion*, *quadrillion*, *quintillion*, *sextillion*, *septillion*, *octillion*, and *nonillion* periods follow in their order.

It is proper to divide any number, before we reckon it into periods and half periods, by different marks. We then begin at the left hand, and read the figures in their order, with the names of their places, from the table. In writing any number, we must be careful to mark the figures in their proper places, and supply the vacant places with cyphers.

As there are no possible ways of changing numbers, except by enlarging or diminishing them according to some given rule, it follows, that the whole art of arithmetic is comprehended in two operations, *Addition* and *Subtraction*. However, as it is frequently required to add several equal numbers together, or to subtract several equal ones from a greater, till it be exhausted, proper methods have been invented for facilitating the operation in these cases, and distinguished by the names of *Multiplication* and *Division*; and these four rules are the foundation of all arithmetical operations whatever.

As the idea of number is acquired by observing several objects collected, so is that of fractions by observing an object divided into several parts. As we sometimes meet with objects broken into two, three, or more parts, we may consider any or all of these divisions promiscuously, which is done in the doctrine of vulgar fractions, for which a chapter will be allotted. However, since the practice of collecting units into parcels of tens has prevailed universally, it has been found convenient to follow a like method in the consideration of fractions, by dividing each unit into ten equal parts, and each of these into ten smaller parts; and so on. Numbers divided in this manner are called *Decimal Fractions*.

Chap. II. ADDITION.

Addition is that operation by which we find the amount of two or more numbers. The method of doing this in simple cases is obvious, as soon as the meaning of number is known, and admits of no illustration. A young learner will begin at one of the numbers, and reckon up as many units separately as there are in the other, and practice will enable him to do it at once. It is impossible strictly speaking, to add more than two numbers at a time. We must first find the sum of the first and second; then we add the third to that number; and so on. However, as the several sums obtained are easily retained in the memory, it is neither necessary nor usual to mark them down. When the numbers consist of more figures than one, we add the units together, the tens together, and so on. But if the sum of the units exceed ten, or contain ten several times, we add the number of tens it contains to the next column, and only set down the number of units that are over. In like manner we carry the tens of every column to the next higher. And the reason of this is obvious from the value of the places; since an unit, in any higher place, signifies the same thing as ten in the place immediately lower.

	Example.
Rule. "Write the numbers distinctly,	346863
" units under units, tens under tens; and	876734
" so on. Then reckon the amount of the	123467
" right-hand column. If it be under ten,	314213
" mark it down. If it exceed ten, mark	712316
" the units only, and carry the tens to the	438987
" next place. In like manner, carry the	279654
" tens of each column to the next, and mark	———
" down the full sum of the left hand co-	3092234
" lumn."	24433

As it is of great consequence in business to perform addition readily and exactly, the learner ought to practise it till it become quite familiar. If the learner can readily add any two digits, he will soon add a digit to a higher number with equal ease. It is only to add the unit place of that number to the digit; and, if it exceed ten, it raises the amount accordingly. Thus, because 8 and 6 is 14, 48 and 6 is 54. It will be proper to mark down under the sums of each column, in a small hand, the figure that is carried to the next column. This prevents the trouble of going over the whole operation again, in case of interruption or mistake. If you want to keep the account clean, mark down the sum and figure you carry on a separate paper, and, after revising them, transcribe the sum only. After some practice, we ought to acquire the habit of adding two or more figures at one glance. This is particularly useful when two figures which amount to 10, as 6 and 4, or 7 and 3, stand together in the column.

Every operation in arithmetic ought to be revised, to prevent mistakes; and as one is apt to fall into the same mistake, if he revise it in the same manner he performed it, it is proper either to alter the order, or else to trace back the steps by which the operation advanced, which will lead us at last to the number we began with. Every method of proving accounts may be referred to one or other of these heads.

1st, Addition may be proven by any of the following methods: repeat the operation, beginning at the top of the column, if you began at the foot when you wrought it.

2d, Divide the account into several parts; add these separately, and then add the sums together. If their amount correspond with the sum of the account, when added at once, it may be presumed right. This method is particularly proper when you want to know the sums of the parts, as well as that of the whole.

3d, Subtract the numbers successively from the sum; if the account be right, you will exhaust it exactly, and find no remainder.

When the given number consists of articles of different value, as pounds, shillings, and pence, or the like, which are called *different denominations*, the operations in arithmetic must be regulated by the value of the articles. We shall give here a few of the most useful tables for the learner's information.

I. *Sterling Money.*	II. *Averdupoise Weight.*
4 Farthings=1 penny, *marked* d.	16 Drams=1 ounce, oz.
12 Pence=1 Shilling, s.	16 Ounces=1 pound, lb.
20 Shillings=1 Pound, L.	28 Pound=1 quarter, qr.
Also, 6 s. 8 d.=1 noble	4 Quart=1 hun. wght, C.
10 s.=1 angel	20 Hun. weight=1 ton, T.
13 s. 4 d. or two-thirds of a pound=1 merk.	

Scots money is divided in the same manner as Sterling, and has one-twelfth of its value. A pound Scots is equal to 1 s. 8 d. Sterling, a shilling Scots to a penny Sterling, and a penny Scots to a twelfth-part of a penny Sterling; a mark Scots is two-thirds of a pound Scots, or $13\frac{1}{3}$ d. Sterling.

III. *Troy Weight.*	IV. *Apothecaries Weight.*
20 Mites=1 grain, gr.	20 Grains=1 scruple, ℈
24 Grain=1 pen. wt. dwt.	3 Scruples=1 dram, ʒ
20 Pen. wts.=1 ounce, oz.	8 Drams=1 ounce, ℥
12 Ounces=1 pound, lb.	12 Ounces=1 pound, ℔

V. *English Dry Measure.*	VI. *Scotch Dry Measure.*
2 Pints=1 quart	4 Lippies=1 peck
4 Quarts=1 gallon	4 Pecks=1 firlot
2 Gallons=1 peck	4 Firlots=1 boll
4 Pecks=1 bushel	16 Bolls=1 chalder
8 Bushels=1 quarter	

VII. *English Land Measure.*	VIII. *Scots Land Measure.*
$30\frac{1}{4}$ Square yards=1 pole or perch	36 Square ells=1 fall
40 Poles=1 rood	40 Falls=1 rood
4 Roods=1 acre	4 Roods=1 acre

IX. *Long Measure.*	X. *Time.*
12 Inches=1 foot	60 Seconds=1 minute
3 Feet=1 yard	60 Minutes=1 hour
$5\frac{1}{2}$ Yards=1 pole	24 Hours=1 day
40 Poles=1 furlong	7 Days=1 week
8 Furlongs=1 mile	365 Days=1 year
3 Miles=1 league.	52 Weeks & 1 day=1 year.

RULE *for compound Addition.* "Arrange like "quantities under like, and carry according to the "value of the higher place."

Note 1. When you add a denomination, which contains more columns than one, and from which you carry to the higher by 20, 30, or any even number of tens, first add the units of that column, and mark down their sum, carrying the tens to the next column; then add the tens, and carry to the higher denomination, by the number of tens that it contains of the lower. For example, in adding shillings, carry by ten from the units to the tens, and by two from the tens to the pounds.

Note 2. If you do not carry by an even number of tens, first find the complete sum of the lower denomination, then enquire how many of the higher that sum contains, and carry accordingly, and mark the remainder, if any, under the column. For example, if the sum of a column of pence by 43, which is three shillings and seven pence, mark 7 under the pence-column, and carry 3 to that of the shillings.

Note 3. Some add the lower denominations after the following method: when they have reckoned as many as amounts to one of the higher denomination, or upwards, they mark a dot, and begin again with the excess of the number reckoned above the value of the denomination. The number of dots shows how many are carried, and the last reckoned number is placed under the column.

Examples in Sterling Money.

L	145	6	8	L	16	9	$11\frac{1}{2}$
	215	3	9		169	16	10
	172	18	4		36	12	$9\frac{3}{4}$
	645	7	7		54	7	6
	737	2	3		30	—	$1\frac{1}{4}$
	35	3	9		7	19	6
	9	—	7		707	19	11
	1764	12	3		14	14	4
	780	—	—		84	18	$8\frac{3}{4}$
	99	9	9		125	3	7
	150	10	—		16	16	$8\frac{3}{4}$
	844	8	7		62	5	3

In Averdupoise Weight.

T.	*C.*	*qr.*	*lb.*	*T.*	*C.*	*qr.*	*lb.*
1	19	3	26	3	15	2	22
—	14	1	16	6	3	—	19
2	18	1	16	5	7	3	26
—	1	2	27	3	2	2	—
3	9	—	10	4	3	1	10
—	17	2	24	—	18	1	12
—	15	3	18	1	1	1	1
4	6	—	5	5	3	—	7
—	6	3	9	6	4	—	9
6	4	—	4	4	6	—	5
5	5	—	5	2	1	3	4

When one page will not contain the whole account, we add the articles it contains, and write against their sum, *Carried forward*; and we begin the next page with the sum of the foreging, writing against it, *Brought forward*.

When the articles fill several pages, and their whole sum is known, which is the case in transcribing accounts, it is best to proceed in the following manner: Add the pages, placing the sums on a separate paper; then add the sums, and if the amount of the whole be right, it only remains to find what numbers should be placed at the foot and top of the pages. For this purpose, repeat the sum of the first page on the same line; add the sums of the first and second, placing the amount in a line with the second; to this add the sum of the third, placing the amount in a line with the third. Proceed in like manner with the others; and if the last sum corresponds with the amount of the pages, it is right. These sums are transcribed at the foot of the respective pages, and tops of the following ones.

Subtraction.

Examples.

L			L			L			L		
134	6	8									
42	3	9	170	5	4	70	4	2	15	3	9
175	4	9	66	9	8	18	6	8	12	2	6
42	5	7	73	8	6	12	13	2	7	5	4
163	7	4	45	3	2	15	3	9	8	—	—
148	5	8	78	7	9	17	5	4	—	9	6
73	2	3	12	—	—	18	6	8	—	5	10
L			L			L			L		

1st Page,	L778	16	—	L	778	16	—
2d	445	14	5		1224	10	5
3d	151	19	9		1376	10	2
2th	43	6	11		1419	17	1
	L1419	17	1				

Then we transcribe L778, 16s. at the foot of the first and top of the second pages, L1224 : 10 : 5 at the foot of the second and top of the third ; and so on.

Chap. III. SUBTRACTION.

Subtraction is the operation by which we take a lesser number from a greater, and find their differences. It is exactly opposite to addition, and is performed by learners in a like manner, beginning at the greater and reckoning downwards the units of the lesser. The greater is called the *minuend*, and the lesser the *subtrahend*.

If any figure of the subtrahend be greater than the corresponding figure of the minuend, we add ten to that of the minuend, and, having found and marked the difference, we add one to the next place of the subtrahend. This is called *borrowing ten.* The reason will appear, if we consider that, when two numbers are equally increased by adding the same to both, their difference will not be altered. When we proceed as directed above, we add ten to the minuend, and we likewise add one to the higher place of the subtrahend, which is equal to ten of the lower place.

Rule. "Subtract units from units, tens from tens, "and so on. If any figure of the subtrahend be "greater than the corresponding one of the minuend, "borrow ten."

Example.			
	Minuend	173694	738641
	Subtrahend	21453	379235
	Remainder	152241	359406

To prove subtraction, add the subtrahend and remainder together ; if their sum be equal to the minuend, the account is right.

Or subtract the remainder from the minuend. If the difference be equal to the subtrahend, the account is right.

Rule *for compound subtraction.* "Place like deno- "minations under like, and borrow, when necessary, "according to the value of the higher place."

Examples.

			C.	*qr.*	*lb.*	*A.*	*R.*	*F.*	*E.*
L 146	3	3	12	3	19	15	2	24	18
58	7	6	4	3	24	12	2	36	7
L 87	15	9	7	3	23	2	3	28	11

Note 1. The reason for borrowing is the same as in simple subtraction. Thus, in subtracting pence, we add 12 pence when necessary to the minuend, and at the next step, we add one shilling to the subtrahend.

Note 2. When there are two places in the same denomination, if the next higher contain exactly so many tens, it is best to subtract the units first, borrowing ten when necessary; and then subtract the tens, borrowing, if there is occasion, according to the number of tens in the higher denomination.

Note 3. If the value of the higher denomination be not an even number of tens, subtract the units and tens at once, borrowing according to the value of the higher denomination.

Note 4. Some chuse to subtract the place in the subtrahend, when it exceeds that of the minuend, from the value of the higher denomination, and add the minued to the difference. This is only a different order of proceeding, and gives the same answer.

Note 5. As custom has established the method of placing the subtrahend under the minuend, we follow it when there is no reason for doing otherwise ; but the minuend may be placed under the subtrahend with equal propriety; and the learner should be able to work it either way, with equal readiness, as this last is sometimes more convenient; of which instances will occur afterwards.

Note 6. The learner should also acquire the habit, when two numbers are marked down, of placing such a number under the lesser, that, when added together, the sum may be equal to the greater. The operation is the same as subtraction, though conceived in a different manner, and is useful in balancing accounts, and on other occasions.

It is often necessary to place the sums in different columns, in order to exhibit a clear view of what is required. For instance, if the values of several parcels of goods are to be added, and each parcel consists of several articles, the particular articles should be placed in an inner column, and the sum of each parcel extended to the outer column, and the total added there.

If any person be owing an account, and has made some partial payments, the payments must be placed in an inner column, and their sum extended under that of the account in the outer column, and subtracted there.

An example or two will make this plain.

1st.] 30 yards linen at 2s.	L. 3		
45 ditto at 1s. 6d.	3 7 6		
		L.	6 7 6
120 lb thread at 4s.	L. 24		
40 ditto at 3s.	6		
30 ditto at 2s. 6d.	3 15		
			33 15
		L.	40 2 6

[2d. 1773.			
Jan. 15. Lent James Smith	L. 50		
22. Lent him further	70		
		L.	120
Feb. 3. Received in part	L. 62		
5. Received further			
In gold L. 10 10			
In silver 13			
	23 10		
			85 10
Balance due me		L.	34 10

Multiplication.

Chap. IV. MULTIPLICATION.

In Multiplication, two numbers are given, and it is required to find how much the first amounts to, when reckoned as many times as there are units in the second. Thus, 8 multiplied by 5, or 5 times 8, is 40. The given numbers (8 and 5) are called *factors*; the first (8) the *multiplicand*; the second (5) the *multiplier*; and the amount (40) the *product*.

This operation is nothing else than addition of the same number several times repeated. If we mark 8 five times under each other, and add them, the sum is 40: But, as this kind of addition is of frequent and extensive use, in order to shorten the operation, we mark down the number only once, and conceive it to be repeated as often as there are units in the multiplier.

For this purpose, the learner must be thoroughly acquainted with the following multiplication-table, which is composed by adding each digit twelve times.

Twice		Thrice		Four times		Five times		Six times		Seven times	
1 is	2	1 is	3	1 is	4	1 is	5	1 is	6	1 is	7
2	4	2	6	2	8	2	10	2	12	2	14
3	6	3	9	3	12	3	15	3	18	3	21
4	8	4	12	4	16	4	20	4	24	4	28
5	10	5	15	5	20	5	25	5	30	5	35
6	12	6	18	6	24	6	30	6	36	6	42
7	14	7	21	7	28	7	35	7	42	7	49
8	16	8	24	8	32	8	40	8	48	8	56
9	18	9	27	9	36	9	45	9	54	9	63
10	20	10	30	10	40	10	50	10	60	10	70
11	22	11	33	11	44	11	55	11	66	11	77
12	24	12	36	12	48	12	60	12	72	12	84

Eight times		Nine times		Ten times		Eleven times		Twelve times	
1 is	8	1 is	9	1 is	10	1 is	11	1 is	12
2	16	2	18	2	20	2	22	2	24
3	24	3	27	3	30	3	33	3	36
4	32	4	36	4	40	4	44	4	48
5	40	5	45	5	50	5	55	5	60
6	48	6	54	6	60	6	66	6	72
7	56	7	63	7	70	7	77	7	84
8	64	8	72	8	80	8	88	8	96
9	72	9	81	9	90	9	99	9	108
10	80	10	90	10	100	10	110	10	120
11	88	11	96	11	110	11	121	11	132
12	96	12	108	12	120	12	132	12	144

If both factors be under 12, the table exhibits the product at once. If the multiplier only be under 12, we begin at the unit-place, and multiply the figures in their order, carrying the tens to the higher place, as in addition.

Ex. 76859 multiplied by 4, or 76859 added 4 times.

```
 76859        76859
     4        76859
 ------       76859
 307436       76859
              ------
              307436
```

If the multiplier be 10, we annex a cypher to the multiplicand. If the multiplier be 100, we annex two cyphers; and so on. The reason is obvious, from the use of cyphers in notation.

If the multiplier be any digit, with one or more cyphers on the right hand, we multiply by the figure, and annex an equal number of cyphers to the product. Thus, if it be required to multiply by 50, we first multiply by 5, and then annex a cypher. It is the same thing as to add the multiplicand fifty times; and this might be done by writing the account at large, dividing the column into 10 parts of 5 lines, finding the sum of each part, and adding these ten sums together.

If the multiplier consist of several significant figures, we multiply separately by each, and add the products. It is the same as if we divided a long account of addition into parts corresponding to the figures of the multiplier.

Example. To multiply 7329 by 365.

```
 7329     7329     7329        36645 =   5 times.
    5       60      300       439740 =  60 times.
 -----   ------   -------    2198700 = 300 times.
 36645   439740   2198700    -------   ---
                             2675085 = 365 times.
```

It is obvious that 5 times the multiplicand added to 60 times, and to 300 times, the same must amount to the product required. In practice, we place the products at once under each other; and, as the cyphers arising from the higher places of the multiplier, are lost in the addition, we omit them. Hence may be inferred the following

Rule. "Place the multiplier under the multiplicand, and multiply the latter successively by the significant figures of the former; placing the right-hand figure of each product under the figure of the multiplier from which it arises; then add the product."

```
Ex.   7329      42785      37846        93956
       365         91        235         8704
   -------    -------    -------      -------
     36645      42785     189230       375834
    43974     385065     113538      657692
   21987      -------    75692      751648
   -------    3893435    -------    ---------
   2675085               8893810    817793024
```

A number which cannot be produced by the multiplication of two others is called a *prime number*; as 3, 5, 7, 11, and many others.

A number which may be produced by the multiplication of two or more smaller ones, is called a *composite number*. For example, 27, which arises from the multiplication of 9 by 3; and these numbers (9 and 3) are called the *component parts* of 27.

Contractions and Varieties in Multiplication.

First, If the multiplier be a composite number, we may multiply successively by the component parts.

```
Ex. 7638 by 45 or 5 times 9   7638   1st,   5492 by  72
      45                         9   2d,   13759 by  56
    ------                  ------   3d,   56417 by 144
     38190                   68472   4th,  73048 by  84
     30552                       5   5th, 166549 by 125
    ------                  ------   6th, 378914 by  54
    343710                  343710   7th, 520813 by  63
```

Because the second product is equal to five times the first, and the first is equal to nine times the multiplicand,

plicand, it is obvious that the second product must be five times nine, or forty-five times as great as the multiplicand.

Secondly, If the multiplier be 5, which is the half of 10, we may annex a cypher and divide by 2. If it be 25, which is the fourth-part of an 100, we may annex two cyphers, and divide by 4. Other contractions of the like kind will readily occur to the learner.

Thirdly, To multiply by 9, which is one less than 10, we may annex a cypher, and subtract the multiplicand from the number it composes. To multiply by 99,999, or any number of 9's, annex as many cyphers, and subtract the multiplicand. The reason is obvious; and a like rule may be found, though the unit place be different from 9.

Fourthly, Sometimes a line of the product is more easily obtained from a former line of the same than from the multiplicand.

```
Ex. 1st.]   1372          2d.]   1348
              84                   36
            ----                 ----
            5488                 8088
           10976                 4044
          ------                -----
          115248                48528
```

In the first example, instead of multiplying by 5, we may multiply 5488 by 2: and, in the second, instead of multiplying by 3, we may divide 8088 by 2.

Fifthly, Sometimes the product of two or more figures may be obtained at once, from the product of a figure already found.

```
Ex. 1st.]  14356          2d.]   3462321
             648                   96484
          ------               ---------
          114848               13849284
          918784              166191408
         -------             332382816
         9302688             -------------
                             334058579364
```

In the second example, we multiply first by 4; then, because 12 times 4 is 48, we multiply the first line of the product by 12, instead of multiplying separately by 8 and 4; lastly because twice 48 is 96, we multiply the second line of the product by 2, instead of multiplying separately by 6 and 9.

When we follow this method, we must be careful to place the right-hand figure of each product under the right-hand figure of that part of the multiplier which it is derived from.

It would answer equally well in all cases, to begin the work at the highest place of the multiplier; and contractions are sometimes obtained by following that order.

```
Ex. 1st.] 3125      or     3125       2d.]  32452
           642              642              52575
         -----            -----         ----------
         18750            18750          162260
          12500            131250          811300
           6250           -------           2433900
         -------          2006250       ----------
         2006250                        1706163900
```

It is a matter of indifference which of the factors be used as the multiplier; for 4 multiplied by 3 gives the same product as 3 multiplied by 4; and the like holds universally true. To illustrate this, we may mark three rows of points, four in each row, placing the rows under each other; and we shall also have four rows containing three points each, if we reckon the rows downwards.

```
. . . .
. . . .
. . . .
```

Multiplication is proven by repeating the operation, using the multiplier for the multiplicand, and the multiplicand for the multiplier. It may also be proven by division, or by casting out the 9's; of which afterwards; and an account, wrought by any contraction, may be proven by performing the operation at large, or by a different contraction.

Compound Multiplication.

RULE I. "If the multiplier do not exceed 12, the "operation is performed at once, beginning at the "lowest place, and carrying according to the value "of the higher place."

```
Examples.]              Cwt. qr. lb.    A. R. P.    lb. oz. dwt.
L.  13  6  7             12   2   8     13  3 18     7   5   9
           9                      5             6            12
   ---------             ----------     --------    -----------
L. 119 19  3             62   3  12     83  — 28    89   5   8
```

RULE II. "If the multiplier be a composite number, whose component parts do not exceed 12, multiply first by one of these parts, then multiply the "product by the other. Proceed in the same manner if there be more than two."

```
Ex. 1st.]  L.   15  3  8 by 32=8×4
                       8
           ---------------
           L.  121  9  4=8 times.
                       4
           ---------------
           L.  485 17  4=32 times.

   2d.]    L.   17  3  8 by 75=5×5×3
                       3
           ---------------
           L.   51 11  —=3 times.
                       5
           ---------------
           L.  257 15  —=15 times.
                       5
           ---------------
           L. 1288 15  —=75 times.
```

Note 1. Although the component parts will answer in any order, it is best, when it can be done, to take them in such order as may clear off some of the lower places at the first multiplication, as is done in Ex. 2d.

Note 2. The operation may be proved, by taking the component parts in a different order, or dividing the multiplier in a different manner.

Rule III. "If the multiplier be a prime number, "multiply first by the composite number next lower, "then by the difference, and add the products."

L.

Multiplication.

L. 35 17 9	by 67=64+3		
8	64= 8+8		
L. 287 2 —	=8 times.		
8			
L. 2296 16 —	=64 times.		
107 13 3	= 3 times.		
L. 2404 9 3	=67 times.		

Here because 8 times 8 is 64, we multiply twice by 8, which gives L. 2296, 16 s. equal to 64 times the multiplicand; then we find the amount of 3 times the multiplicand, which is L. 107 : 13 : 3: and it is evident that these added, amount to 67, the multicand.

Rule IV. "If there be a composite number a little above the multiplier, we may multiply by that number, and by the difference, and subtract the second product from the first."

L. 17 4 5	by 106=108—2	
12	108= 9×12	
L. 206 13 —		
9		
L. 1859 17 —	=108 times.	
34 8 10	= 2 times.	
L. 1825 8 2	=106 times	

Here we multiply by 12 and 9, the component parts of 108, and obtain a product of L. 1860, 6 s. equal to 108 times the multiplicand; and, as this is twice oftener than was required, we subtract the multiplicand doubled, and the remainder is the number sought.

Example. L. 34 : 8 : 2½ by 3465.

Rule V. "If the multiplier be large, multiply by 10, and multiply the product again by 10; by which means you obtain an hundred times the given number. If the multiplier exceed 1000, multiply by 10 again; and continue it farther if the multiplier require it; then multiply the given number by the unit-place of the multiplier; the first product by the ten place, the second product by the hundred-place; and so on. Add the products thus obtained together."

L.	34 8 2½ by 5=	L. 172 1 ½=	5 times
	10		
10 times L.	344 2 1 by 6=	2064 12 6=	60 times
	10		
100 times L.	3441 — 10 by 4=	13764 3 4=	400 times
	10		
1000 times L.	34410 8 4 by 3=	103231 5 —=	3000 times.
		L. 119232 1 10½=	3465 times

The use of multiplication is to compute the amount of any number of equal articles, either in respect of measure, weight, value, or any other consideration. The multiplicand expresses how much is to be reckoned for each article; and the multiplier expresses how many times that is to be reckoned. As the multiplier points out the number of articles to be added, it is always an abstract number, and has no reference to any value or measure whatever. It is therefore quite improper to attempt the multiplication of shillings by shillings, or to consider the multiplier as expressive of any denomination. The most common instances in which the practice of this operation is required, are, to find the amount of any number of parcels, to find the value of any number of articles, to find the weight or measure of a number of articles, &c.

Division.

This computation, for changing any sum of money, weight, or measure, into a different kind, is called Reduction. When the quantity given is expressed in different denominations, we reduce the highest to the next lower, and add thereto the given number of that denomination; and proceed in like manner till we have reduced it to the lowest denomination.

Example. To reduce L. 46 : 13 : 8¾ to farthings.

L. 46	
20	Or thus:
920 shillings in L. 46	L 46 13 8¾
13	20
933 shillings in L. 46 13	933
12	12
11196 pence in L. 46 13	11204
8	4
11204 pence in L. 46 13 8	44819
4	
44816 farthings in L. 46 13 8	
3	
44819 farthings in L. 46 13 8¾	

It is easy to take in or add the higher denomination at the same time we multiply the lower,

Chap. V. DIVISION. 11

In division, two numbers are given; and it is required to find how often the former contains the latter. Thus, it may be asked how often 21 contains 7, and the answer is exactly 3 times. The former given number (21) is called the *Dividend*; the latter (7) the *Divisor*; and the number required (3) the *Quotient*. It frequently happens that the division cannot be completed exactly without fractions. Thus it may be asked, how often 8 is continued in 19? the answer is twice, and a remainder of 3.

This operation consists in subtracting the divisor from the dividend, and again from the remainder, as often as it can be done, and reckoning the number of subtractions; as,

21	19
7 first subtraction	8 first subtraction
14	11
7 second subtraction	8 second subtraction
7	3 remainder.
7 third subtraction.	
0	

As this operation, performed at large, would be very tedious, when the quotient is a high number, it is proper to shorten it by every convenient method; and, for this purpose, we may multiply the divisor by any number whose product is not greater than the dividend, and so subtract it twice or thrice, or oftener, at the same time. The best way is to multiply it by the greatest number, that does not raise the product too high, and that number is also the quotient. For example, to divide 45 by 7, we inquire what is the greatest multiplier for 7, that does not

Diviſion. not give a product above 45; and we ſhall find that it is 6; and 6 times 7 is 42, which, ſubtracted from 45, leaves a remainder of 3. Therefore 7 may be ſubtracted 6 times from 45; or, which is the ſame thing, 45, divided by 7, gives a quotient of 6, and a remainder of 3.

If the diviſor do not exceed 12, we readily find the higheſt multiplier that can be uſed from the multiplication table. If it exceed 12, we may try any multiplier that we think will anſwer. If the product be greater than the dividend, the multiplier is too great; and, if the remainder, after the product is ſubtracted from the dividend, be greater than the diviſor, the multiplier is too ſmall. In either of theſe caſes, we muſt try another. But the attentive learner, after ſome practice, will generally hit on the right multiplier at firſt.

If the diviſor be contained oftener than ten times in the dividend, the operation requires as many ſteps as there are figures in the quotient. For inſtance, if the quotient be greater than 100, but leſs than a 1000, it requires 3 ſteps. We firſt inquire how many hundred times the diviſor is contained in the dividend, and ſubtract the amount of theſe hundreds. Then we inquire how often it is contained ten times in the remainder, and ſubtract the amount of theſe tens. Laſtly, we inquire how many ſingle times it is contained in the remainder. The method of proceeding will appear from the following example:

To divide 5936 by 8.

From	5936	
Take	5600 =	700 times 8
Rem.	336	
From which take	320 =	40 times 8
Rem.	16	
From which take	16 =	2 times 8
	0	742 times 8 in all.

It is obvious, that as often as 8 is contained in 59, ſo many hundred times it will be contained in 5900, or in 5936; and, as often as it is contained in 33, ſo many times it will be contained in 330, or in 336; and thus the higher places of the quotient will be obtained with equal eaſe as the lower. The operation might be performed by ſubtracting 8 continually from the dividend, which will lead to the ſame concluſion by a very tedious proceſs. After 700 ſubtractions, the remainder would be 336; after 40 more, it would be 16; and after 2 more, the dividend would be entirely exhauſted. In practice, we omit the cyphers, and proceed by the following

Rule 1ſt, "Aſſume as many figures on the left "hand of the multiplier as contain the diviſor once "or oftener: find how many times they contain it, "and place the anſwer as the higheſt figure of the "quotient.

2d, "Multiply the diviſor by the figure you have "found, and place the product under the part of "the dividend from which it is obtained.

3d, "Subtract the product from the figures above it.

4th, "Bring down the next figure of the dividend "to the remainder, and divide the number it makes "up, as before."

Examples.] 1ſt. 8)5936(742 2d. 63)30114(478 Diviſion.

```
1st. 8)5936(742        2d. 63)30114(478
       56··                  252··
       ----                  ----
        33                    491
        32                    441
        --                    ---
         16                    504
         16                    504
         --                    ---
          0                      0

3d. 365)974932(2671 17/365
        730···
        ----
        2449
        2190
        ----
         2593
         2555
         ----
          382
          365
          ---
Remainder  17
```

The numbers which we divide, as 59, 33, and 16, in the firſt example, are called *dividuals*.

It is uſual to mark a point under the figures of the dividend, as they are brought down, to prevent miſtakes.

If there be a remainder, the diviſion is completed by a vulgar fraction, whoſe numerator is the remainder, and its denominator the diviſor. Thus, in Ex. 3. the quotient is 2671, and remainder 17; and the quotient completed is 2671 $\frac{17}{365}$.

A number which divided another without a remainder is ſaid to meaſure it; and the ſeveral numbers which meaſure another, are called its *aliquot parts*. Thus, 2, 4, 6, 8, and 12, are aliquot parts of 24. As it is often uſeful to diſcover numbers which meaſure others, we may obſerve,

1ſt, Every number ending with an even figure, that is, with 2, 4, 6, 8, or 0, is meaſured by 2.

2d, Every number ending with 5, or 0, is meaſured by 5.

3d, Every number, whoſe figures, when added, amount to an even number, of 3's or 9's, is meaſured by 3 or 9, reſpectively.

Contractions and Varieties in Diviſion.

Firſt, When the diviſor does not exceed 12, the whole computation may be performed without ſetting down any figures except the quotient.

```
Ex. 7)35868(5124     or     7)35868
                              5124
```

Secondly, When the diviſor is a compoſite number, and one of the component parts alſo meaſures the dividend, we may divide ſucceſſively by the component parts.

```
Ex. 1st.] 30114 by 63.    2d.] 975 by 105=5×7×3
        9)30114                5)975
        7) 3346                3)195
  Quotient  478                7) 65
                        Quotient   9 2/7
```

This method might be alſo uſed, although the component parts of the diviſor do not meaſure the dividend; but the learner will not underſtand how to manage

manage the remainder till he be acquainted with the doctrine of vulgar fractions.

Thirdly, When there are cyphers annexed to the divisor, cut them off, and cut off an equal number of figures from the dividend; annex these figures to the remainder. *Ex.* To divide 378643 by 5200.

$52|00)3786|43(72\frac{4243}{5200}$

```
52|00)3786|43(72
      364·
      ----
       146
       104
       ----
       4243
```

The reason will appear by performing the operation at large, and comparing the steps.

To divide by 10, 100, 1000, or the like. Cut off as many figures on the right hand of the dividend as there are cyphers in the divisor. The figures which remain on the left hand compose the quotient, and the figures cut off compose the remainder.

Fourthly, When the divisor consists of several figures we may try them separately, by inquiring how often the first figure of the divisor is contained in the first figure of the dividend, and then considering whether the second and following figures of the divisor be contained as often in the corresponding ones of the dividend with the remainder (if any) prefixed. If not, we must begin again, and make trial of a lower number. When the remainder is nine, or upwards, we may be sure the division will hold through the lower places; and it is unnecessary to continue the trial farther.

Fifthly, We may make a table of the products of the divisor, multiplied by the nine digits, in order to discover more readily how often it is contained in each dividual. This is convenient when the dividend is very long, or when it is required to divide frequently by the same divisor.

```
73 by 2 = 146        73)538726949(737982
      3 = 219           511·····
      4 = 292           ---
      5 = 365            277
      6 = 438            219
      7 = 511            ---
      8 = 584             582
      9 = 657             511
                          ---
                           716
                           657
                           ---
                            599
                            584
                            ---
                             154
                             146
                             ---
                        Rem.   8
```

Sixthly, To divide by 9, 99, 999, or any number of 9's, transcribe under the dividend part of the same, shifting the highest figure as many places to the right, as there are 9's in the divisor. Transcribe it again, with the like change of place, as often as the length of the dividend admits; add these together, and cut off as many figures from the right hand of the sum as there are 9's in the divisor. The figures which remain on the left hand compose the quotient, and those cut off the remainder.

If there be any carriage to the unit-place of the quotient, add the number carried likewise to the remainder, as in Ex. 2,; and if the figures cut off be all 9's, add 1 to the quotient, and there is no remainder.

```
Examples. 1st.] 99)324123          2d.] 99)547825
                   3241                     5478
                     32                       54
                -------                  -------
                3273|96                  5533|57
Quotient        3273 and rem. 96.              1
                                         -------
                              Quotient   5333.58 rem.

            3d.] 999)476523
                        476
                    -------
                    476|999
                          1
                    -------
            Quotient 477
```

To explain the reason of this, we must recollect, that whatever number of hundreds any dividend contains, it contains an equal number of 99's, together with an equal number of units. In Ex. 1. the dividend contains 3241 hundreds, and a remainder of 23. It therefore contains 3241 times 99, and also 3241, besides the remainder already mentioned.—Again, 3241 contains 32 hundreds, and a remainder of 51: It therefore contains 32 99's, and also 32, besides the remainder of 41. Consequently the dividend contains 99, altogether, 3241 times, and 32 times, that is 3273 times, and the remainder consists of 23, 41, and 32, added, which makes 96.

As multiplication supplies the place of frequent additions, and division of frequent subtractions, they are only repetitions and contractions of the simple rules, and when compared together, their tendency is exactly opposite. As numbers, increased by addition are diminished and brought back to their original quantity by subtraction; in like manner, numbers compounded by multiplication are reduced by division to the parts from which they were compounded. The multiplier shows how many additions are necessary to produce the number; and the quotient shows how many subtractions are necessary to exhaust it. It follows, that the product, divided by the multiplicand, will quote the multiplier; and, because either factor may be assumed for the multiplicand, therefore the product divided by either factor quotes the other. It follows, also, that the dividend is equal to the product of the divisor and quotient multiplied together: and hence these operations mutually prove each other.

To prove multiplication. Divide the product by either factor. If the operation be right, the quotient is the other factor, and there is no remainder.

To prove division. Multiply the divisor and quotient together; to the product add the remainder, if any; and, if the operation be right, it makes up the dividend. Otherwise divide the dividend (after subtracting the remainder, if any) by the quotient. If the operation be right, it will quote the divisor. The reason of all these rules may be collected from the last paragraph.

Compound

Compound Division.

12 RULE I. "When the dividend only consists of "different denominations, divide the higher denomination, and reduce the remainder to the next "lower, taking in (p. 296. Rule V.) the given number of that denomination, and continue the division."

Examples.

Divide L. 465 : 12 : 8 by 72.

```
   L.  s. d.    L. s. d.
72) 465 12 8    (6 9 4
    432 · · ·
    ---
     33
     20
    ---
72) 672
    648
    ---
     24
     12
    ---
72) 296
    288
    ---
      8 Rem.
```

Or we might divide by the component parts of 72, (as explained under *Thirdly*, p. 298).

Divide 345 cwt. 1 q. 8 lb. by 22.

```
    Cwt. q. lb.   Cwt. q. lb.
22) 345  1  8     (15  2  21
    22· · ·
    ---
    125
    110
    ---
     15
      4
    ---
22)  61
     44
    ---
     17
     28
    ---
    144
     34
    ---
22) 484
     44
    ---
     44
     44
    ---
      0
```

RULE II. "When the divisor is in different denominations, reduce both divisor and dividend to "the lowest denomination, and proceed as in simple "division. The quotient is an abstract number."

To divide L. 38 : 13 s. by L. 3 : 4 : 5.

```
L. 3 4 5   L. 38 13
   20         20
   --         --
   64        773
   12         12
   --         --
  773       )9276(12 quote.
             773
             ---
             1546
             1546
             ----
                0
```

To divide 96 Cwt. 1 q. 20lb. by 3 cwt. 2 q. 8 lb.

```
Cwt. q. lb.   Cwt. q. lb.
 3   2  8 )    96  1  20
 4              4
 --            ---
 14            385
 28             28
 --            ---
120           3100
 28            770
 --           ----
4|00)      108|00(27 quote.
```

It is best not to reduce the terms lower than is necessary to render them equal. For instance, if each of them consists of an even number of sixpences, fourpences, or the like, we reduce them to sixpences, or fourpences, but not to pence.

The use of division is to find either of the factors by whose multiplication a given number is produced when the other factor is given; and therefore is of two kinds, since either the multiplier or the multiplicand may be given. If the former be given, it discovers what that number is which is contained so many times in another. If the latter be given, it discovers how many times one number is contained in another. Thus, it answers the questions of an opposite kind to those mentioned under Rule IV. p. 296. as, To find the quantity of a single parcel or share; to find the value, weight, or measure, of a single article; to find how much work is done, provisions consumed, interest incurred, or the like, in a single day, &c.

The last use of division is a kind of reduction exactly opposite to that described under Rule V. 296. The manner of conducting and arranging it, when there are several denominations in the question, will appear from the following examples.

1. To reduce 15783 pence to pounds, sh. and pence.

```
         20
12) 15783 (1315 (65
    12···   120·
    --     ---
    37     115
    36     100
    --     ---
    18      15
    12
    --
    63
    60
    --
     3
```

Answer, L. 65 : 15 : 3.

2. To reduce 174865 grs. to lbs. oz. and dwt. Troy.

```
              20    12
24) 174865 (7286 (364 (30
    168···   60··  36·
    ---      ---   ---
     68      128    04
     48      120
    ---      ---
    206       86
    192       80
    ---       --
     145       6
     144
     ---
       1
```

Ans. 30lb. 4oz. 6dwt. 1 gr.

In the first example, we reduce 15783 pence to shillings, by dividing by 12, and obtain 1315 shillings, and a remainder of 3 pence. Then we reduce 1315 shillings to pounds, by dividing by 20. and obtain 65 pounds and a remainder of 15 shillings. The divisions might have been contracted.

In the practice of arithmetic, questions often occur which require both multiplication and division to resolve. This happens in reduction, when the higher denomination does not contain an exact number of the lower.

RULE *for mixed reduction.* "Reduce the given denomination by multiplication to some lower one, "which is an aliquot part of both; then reduce that "by division to the denomination required."

Ex. Reduce L. 31742 to guineas.

```
   31742
      20
   ------
21)634840(30230
   63····
   ------
    048
     42
     --
      64
      63
      --
      10
```

Here we multiply by 20, which reduces the pounds to shillings; and divide the product by 21, which reduces the shillings to guineas.

Answer, 30230 guineas and 10 shill.

As

Division.

As Portuguese money frequently passes here in payments, we shall a give a table of the pieces, and their value.

A moidore	=L. 1	7	—
A half moidore	= —	13	6
A quarter moidore	= —	6	9
A double Joannes	= 3	12	—
A Joannes	= 1	16	—
A half ditto	= —	18	—
A quarter ditto	= —	9	—
An eighth ditto	= —	4	6

Note 1. Guineas may be reduced to pounds, by adding one-twentieth part of the number.

2. Pounds may be reduced to merks by adding one-half.

3. Merks may be reduced to pounds by subtracting one-third.

4. Four moidores are equal to three Joannes: wherefore moidores may be reduced to Joannes, by subtracting one-fourth; and Joannes to moidores, by adding one-third.

5. Five Joannes are equal to L. 9. Hence it is easy to reduce Portugueze money to Sterling.

Another case, which requires both multiplication and division, is, when the value, weight, measure, or duration of any quantity is given, and the value, &c. of a different quantity required, we first find the value, &c. of a single article by division, and then the value, &c. of the quantity required, by multiplication.

Ex. If 3 yards cost 15 s. 9 d. what will 7 yards cost, at the same rate?

```
        s.  d.
   3) 15   9 Price of 3 yards.
       5   3 Price of 1 yard by Rule IV. p. 296.
           7
   ———————————
L. 1 16   9 Price of 7 yards (by par. ult. p. 299. col. 1.
```

Many other instances might be adduced, where the operation and the reason of it are equally obvious. These are generally, though unnecessarily, referred to the rule of proportion.

We shall now offer a general observation on all the operations in Arithmetic. When a computation requires several steps, we obtain a just answer, whatever order we follow. Some arrangements may be preferable to others in point of ease, but all of them lead to the same conclusion. In addition, or subtraction, we may take the articles in any order, as is evident from the idea of number; or, we may collect them into several sums, and add and subtract these, either separately or together. When both the simple operations are required to be repeated, we may either complete one of them first, or may introduce them promiscuously; and the compound operations admit of the same variety. When several numbers are to be multiplied together, we may take the factors in any order, or we may arrange them into several classes, find the product of each class, and then multiply the products together. When a number is to be divided by several others, we may take the divisors in any order, or we may multiply them into each other, and divide by the product; or we may multiply them into several parcels, and divide by the products successively. Lastly, when multiplication and division are both required, we may begin with either; and when both are repeatedly necessary, we may collect the multipliers into one product, and the divisors into one another; or we may collect them into parcels, or use them singly, and that in any order. Still, we shall obtain the proper answer, if none of the terms be neglected.

When both multiplication and division are necessary to obtain the answer of a question, it is generally best to begin with the multiplication, as this order keeps the account as clear as possible from fraction. The example last given may be wrought accordingly as follows:

```
      s.  d.
     15   9
          7
   ————————
 3)5  10  3
   1  16  9
```

Some accountants prove the operations of arithmetic by a method which they call casting out the 9's, depending on the following principles:

First, If several numbers be divided by any divisor, (the remainders being always added to the next number), the sum of the quotients, and the last remainder, will be the same as those obtained when the sum of the numbers is divided by the same divisor. Thus, 19, 15, and 23, contain, together, as many 5's, as many 7's, &c. as their sum 57 does, and the remainders are the same; and, in this way, addition may be proven by division. It is from the correspondence of the remainders, that the proof, by casting out the 9's, is deduced.

Secondly, If any figure, with cyphers annexed, be divided by 9, the quotient consists entirely of that figure; and the remainder is also the same. Thus, 40, divided by 9, quotes 4, remainder 4; and 400 divided by 9, quotes 4, remainder 44. The same holds with all the digits; and the reason will be easily understood; every digit, with a cypher annexed, contains exactly so many tens; it must therefore contain an equal number of 9's, besides a remainder of an equal number of units.

Thirdly, If any number be divided by 9, the remainder is equal to the sum of the figures of the number, or to the remainder obtained, when that sum is divided by 9. For instance, 3765, divided by 9, leaves a remainder of 3, and the sum of 3, 7, 6, and 5, is 21; which divided by 9, leaves a remainder of 3. The reason of this will appear from the following illustration:

```
3000 divided by 9 quotes 333;   remainder 3
 700              quotes  77;   remainder 7
  60              quotes   6;   remainder 6
   5              quotes   0;   remainder 5
————                     ———             —
3765                     416 Sum of Rem. 21
Again. 21 divided by 9 quotes  2;  remainder 3
                         ———
```

Wherefore, 3765 divid. by 9 quotes 418; remainder 3; for the reason given. Hence we may collect the following rules for practice:

To cast the 9's out of an number, or to find what remainder will be left when any number is divided by 9: Add the figures; and when the sum exceeds 9, add the figures which would express it. Pass by the nines; and, when the sum comes exactly to 9, neglect it, and begin anew. For example, if it be required to cast the 9's out of 3573294, we reckon thus: 3 and 5 is

5 is 8, and 7 is 15; 1 and 5 is 6, and 3 is 9, which we neglect; 2 and (passing by 9) 4 is 6; which is the remainder or Result. If the article out of which the 9's are to be cast contains more denominations than one, we cast the 9's out of the higher, and multiply the result by the value of the lower, and carry on the product (casting out the 9's, if necessary), to the lower.

To prove addition, cast the 9's out of the several articles, carrying the results to the following articles; cast them also out of the sum. If the operation be right, the results will agree.

To prove subtraction, cast the 9's out of the minuend; cast them also out of the subtrahend and remainder together; and if you obtain the same result, the operation is presumed right.

To prove multiplication, cast the 9's out of the multiplicand, and also out of the multiplier, if above 9. Multiply the results together, and cast the 9's if necessary, out of their product. Then cast the 9's out of the product, and observe if this result correspond with the former.

Ex. 1st.] 9276 res. 6×8=48 res. 3.
8
———
74208 res. 3.

2d.] 7898 res. 5×3=15 res. 6.
48 res. 3.
———
63184
31592
———
379104 res. 6.

The reason of this will be evident, if we consider multiplication under the view of repeated addition. In the first example it is obviously the same. In the second, we may suppose the multiplicand repeated 48 times. If this be done, and the 9's cast out, the result, at the end of the 9th line, will be 0; for any number, repeated 9 times, and divided by 9, leaves no remainder. The same must happen at the end of the 18th, 27th 36th, and 45th lines; and the last result will be the same as if the multiplicand had only been repeated 3 times. This is the reason for casting out the 9's from the multiplier as well as the multiplicand.

To prove division, cast the 9's out of the divisor, and also out of the quotient; multiply the results, and cast the 9's out of the product. If there be any remainder, add to it the result, casting out the 9's, if necessary. If the account be right, the last result will agree with that obtained from the dividend.

Ex. 42) 2490 (59 res. 5×6=30 res. 3.
res. 6 210
———
390
378
———
Rem. 12 - - res. 3.

And the result of the dividend is 6.

This depends on the same reason as the last; for the dividend is equal to the product of the divisor and quotient added to the remainder.

We cannot recommend this method, as it lies under the following disadvantages:

First, If an error of 9, or any of its multiples, be committed, the results will nevertheless agree; and so the error will remain undiscovered. And this will always be the case, when a figure is placed or reckoned in a wrong column; which is one of the most frequent causes of error.

Secondly, When it appears by the disagreement of the results, that an error has been committed, the particular figure or figures in which the error lies are not pointed out; and consequently, it is not easily corrected.

Chap. VI. RULE of PROPORTION. 13

Sect. i. Simple Proportion.

Quantities are reckoned proportional to each other, when they are connected in such a manner, that if one of them be increased or diminished, the other increases or diminishes at the same time; and the degree of the alteration on each is a like part of its original measure; thus four numbers are in the same proportion, the first to the second as the third to the fourth, when the first contains the second, or any part of it, as often as the third contains the fourth, or the like part of it. In either of these cases, the quotient of the first, divided by the second, is equal to that of the third divided by the fourth; and this quotient may be called the *measure of the proportion*.

Proportionals are marked down in the following manner:

6 : 3 :: 8 : 4
12 : 36 :: 9 : 27
9 : 6 :: 24 : 18
16 : 24 :: 10 : 15

The rule of proportion directs us, when three numbers are given, how to find a fourth, to which the third may have the same proportion that the first has to the second. It is sometimes called the *Rule of Three*, from the three numbers given; and sometimes the *Golden Rule*, from its various and extensive utility.

Rule. "Multiply the second and third terms together, and divide the product by the first."

Ex. To find a fourth proportional to 18, 27, and 34.

18 : 27 :: 34 : 51
34
——
108
81
——
18)918(51
90
——
18
18
——
0

To explain the reason of this, we must observe, that if two or more numbers be multiplied or divided alike, the products or quotients will have the same proportion.

18 : 27
Multiplied by 34, 612 : 918
Divided by 18, 34 : 51

The

Proportion

The products 612, 918, and the quotients 34, 51, have therefore the same proportion to each other that 18 has to 27. In the course of this operation, the products of the first and third term is divided by the first; therefore the quotient is equal to the third.

The first and second terms must always be of the same kind; that is, either both monies, weights, measures, both abstract numbers, or the like. The fourth, or number sought, is of the same kind as the third.

When any of the terms is in more denominations than one, we may reduce them all to the lowest. But this is not always necessary. The first and second should not be reduced lower than directed p. 299, col. 1. par. *penult.*; and, when either the second or third is a simple number, the other, though in different denominations, may be multiplied without reduction.

			L.	s.	d.			
Ex. 5 :	7 ::		25	11	3			
					7			
						L.	s.	d.
		5)	178	18	9 (	35	19	9

The accountant must consider the nature of every question, and observe the circumstance which the proportion depends on; and common sense will direct him to this if the terms of the question be understood. It is evident that the value, weight and measure of any commodity is proportioned to its quantity; that the amount of work or consumption is proportioned to the time; that gain, loss or interest, when the rate and time are fixed, is proportioned to the capital sum from which it arises; and that the effect produced by any cause is proportioned to the extent of the cause. In these, and many other cases, the proportion is direct, and the number sought increases or diminishes along with the term from which it is derived.

In some questions, the number sought becomes less, when the circumstances from which it is derived become greater. Thus, when the price of goods increases, the quantity which may be bought for a given sum is smaller. When the number of men employed at work is increased, the time in which they may comple it becomes shorter; and, when the activity of any cause is increased, the quantity necessary to produce a given effect is diminished. In these, and the like, the proportion is said to be inverse.

General Rule *for stating all questions, whether direct or inverse.* "Place that number for the third "term which signifies the same kind of thing with "what is sought, and consider whether the number "sought will be greater or less. If greater, place the "least of the other terms for the first; but, if less, "place the greatest for the first."

Ex. 1st] If 30 horses plough 12 acres, how many will 42 plough in the same time?

H. H. A.
30 : 42 :: 12

Here, because the thing sought is a number of acres, we place 12, the given number of acres, for the third term; and, because 42 horses will plough more than 12, we make the lesser number 30, the first term, and the greater number, 42, the second term.

Ex. 2d.] If 40 horses be maintained for a certain sum on hay, at 5 d. per stone, how many will be maintained on the same sum when the price of hay rises to 8 d.

d. d. H.
8 : 5 :: 40

Here, because a number of horses is sought, we make the given number of horses, 40, the third term; and, because fewer will be maintained for the same money, when the price of hay is dearer, we make the greater price, 8 d. the first term; and the lesser price 5d. the second term.

The first of these examples is direct, the second inverse. Every question consists of a supposition and demand. In the first, the supposition is, that 30 *horses plough* 12 *acres*, and the demand, *how many* 42 *will plough?* and the first term of the proportion, 30, is found in the supposition, in this, and every other direct question. In the second, the supposition is, *that* 40 *horses are maintained on hay at 5d.* and the demand, *how many will be maintained on hay at 8d?* and the first term of the proportion, 8, is found in the demand, in this and every other inverse question.

When an account is stated, if the first and second term, or first and third, be measured by the same number, we may divide them by that measure, and use the quotients in their stead.

Ex. If 36 yards cost 42 shillings, what will 27 cost?

Y. Y. sh.
36 : 27 :: 42
4 : 3 :: 42
3
—— s. d.
4)126(31 6

Here 36 and 27 are both measured by 9, and we work with the quotients 4 and 3.

Sect. ii. Compound Proportion. 14

Sometimes the proportion depends upon several circumstances. Thus, it my be asked, if 18 men consume 6 bolls corn in 28 days, how much will 24 men consume in 56 days? Here the quantity required depends partly on the number of men, partly on the time, and the question may be resolved into the two following ones:

1st. If 18 men consume 6 bolls in a certain time, how many will 24 men consume in the same time?

M. M. B. B.
18 : 24 :: 6 : 8
6
——
18)144(8

Answer. 24 men will consume 8 bolls in the same time.

2d. If a certain number of men consume 8 bolls in 28 days, how many will they consume in 56 days?

D. D. B. B.
28 : 56 :: 8 : 16
8
——
18)448(16

Ans. The same number of men will consume 16 bolls in 56 days.

In the course of this operation, the original number of bolls, 6, is first multiplied into 24, then divided by 18, then multiplied into 8, then divided by 28. It would answer the same purpose to collect the mutipliers into one product, and the divisors into another; and then to multiply the given number of bolls by the former, and divide the product by the latter. p. 300. col. 1. par. *ult.*

The above question may therefore be stated and wrought as follows:

Men

Men 18 : 24 :: 6 bolls
Days 28 : 56

144 144
36 120

504 1344
6

504)8064(16

Here we multiply 18 into 28 for a divifor, and 6 into the product of 24 by 56, for a dividend.

" In general, ftate the feveral particulars on which " the queftion depends, as fo many fimple proportions, " attending to the fenfe of the queftion to difcover " whether the proportions fhould be ftated directly or " inverfely ; then multiply all the terms in the firft " rank together, and all thofe in the fecond rank to- " gether ; and work with the products as directed in " the fimple rule (Sect i. p. 301.)"

Example. If 100 men make 3 miles of road in 27 days, in how many days will 150 men make 5 miles ?

Men 150 : 100 :: 27 days
Miles 3 5

450 500
27

450)13500(30 days, anf.

Here the firft ftating is inverfe, becaufe more men will do it in fewer days; but the fecond is direct, becaufe more miles will require more days.

The following contraction is often ufeful. After ftating the proportion, if the fame number occurs in both ranks, dafh it out from both ; or, if any term in the firft rank, and another in the fecond rank are meafured by the fame numbers, dafh out the original terms, and ufe the quotients in their ftead.

Ex. If 18 men confume L. 30 value of corn in 9 months, when the price is 16 s. per boll, how many will confume L. 54 value in 6 months, when the price is 12 s. per boll ? In this queftion, the proportion depends upon three particulars, the value of corn, the time and the price. The firft of which is direct, becaufe the more the value of provifions is, the more time is required to confume them; but the fecond and third are inverfe, for the greater the time and price is, fewer men will confume an equal value.

Value 30 : 74 :: 18 men.
Months 6 : 9
Price 12 : 16
10 9
3 3
4

36
18

288
36

10)648(64 $\frac{9}{10}$

Here we obferve that 6 in the firft rank meafures 54 in the fecond : fo we dafh them out, and place the quotient 9 in the fecond rank. Next, becaufe 30 and 9 are both meafured by 3, we dafh them out, and place down the quotients 10 and 3; then, becaufe 12 and 16 are both meafured by 4, we dafh them out, and place down the quotients 3 and 4. Laftly, becaufe there is now 3 in both columns, we dafh them out, and work with the remaining terms, according to the rule.

The monies, weights and meafures, of different countries, may be reduced from the proportion which they bear to each other.

Ex. If 112 lb. averdupois make 104 lb. of Holland, and 100 lb. of Holland make 89 of Geneva, and 110 of Geneva make 117 of Seville, how many lbs. of Seville will make 100 lb. averdupois.

112 : 104 :: 100
100 : 89
110 : 117

If it be required, how many lb. averdupois will make 100 of Seville, the terms would have been placed in the different columns thus :

104 : 112 :: 100
89 : 100
117 : 110

Sect. iii. Distributive Proportion. 15

If it be required to divide a number into parts, which have the fame proportion to each other, that feveral other given numbers have, we add thefe numbers together, and ftate the following proportion : As the fum is to the particular numbers, fo is the number required to be divided to the feveral parts fought.

Ex. 1ft.] Four partners engage to trade in company ; A's ftock is L. 150, B's L. 320, C's L. 350, D's L. 500, and they gain L. 730 ; Required how much belongs to each, if the gain be divided among them in proportion to their ftocks ?

					Rem.
A's ftock L.	150	1320 : 150 :: 730 : L. 82	19	1 — 120	
B's	320	1320 : 320 :: 730 : 176	19	4 — 960	
C's	350	1320 : 350 :: 730 : 193	11	2 — 720	
D's	500	1320 : 500 :: 730 : 276	10	3 — 840	
Whole ftock	1320	Proof L. 730			

This account is proved by adding the gains of the partners ; the fum of which will be equal to the whole gain, if the operation be right ; but, if there be remainders, they muft be added, their fum divided by the common divifor, and the quotient carried to the loweft place.

Ex. 2d.] A bankrupt owes A L. 146, B L. 170, C L. 45, D L 480, and E L. 72 ; his whole effects are only L. 342 : 7 : 6. How much fhould each have ?

A's debt L.	146	913 : 146 ::	L. 342 7 6 :	L. 54 15		A's fhare.
B's	170	913 : 170 ::	342 7 6	63 15		B's
C's	45	913 : 45 ::	342 7 6	16 17	6	C's
D's	480	913 : 480 ::	342 7 6	180		D's
E's	72	913 : 72 ::	342 7 6	27		E's
	L. 913			L. 342 7	6	

This might alfo be calculated, by finding what compofition the bankrupt was able to pay per pound ; which is obtained by dividing the amount of his effects by the amount of his debts; and comes to 7 s. 6 d. and then finding by the rules of practice, how much each debt came to at that rate.

Chap. VII. RULES for PRACTICE. 16

The operations explained in the foregoing chapters comprehend the whole fyftem of arithmetic, and are fufficient for every computation. In many cafes, however, the work may be contracted, by adverting to the particular circumftances of the queftion. We fhall explain, in this chapter, the moft ufeful methods which practice has fuggefted for rendering mercantile computations eafy ; in which, the four elementary rules of arithmetic are fometimes jointly, fometimes feparately employed.

Sect. i. Computation of Prices.

The value of any number of articles, at a pound, a fhilling

Practice.

ſhillings, or a penny, is an equal number of pounds, ſhillings or pence; and theſe two laſt are eaſily reduced to pounds. The value, at any other rate, may be calculated by eaſy methods, depending on ſome contraction already explained, or on one or more of the following principles.

1ſt, If the rate be an aliquot part of a pound, a ſhilling, or a penny, then an exact number of articles may be bought for a pound, a ſhilling, or a penny; and the value is found by dividing the given number accordingly. Thus, to find the price of ſo many yards at 2s. 6d. which is the eighth-part of a pound, we divide the quantity by eight, becauſe every eight yards coſt L. 1.

2d, If the rate be equal to the ſum of two other rates which are eaſily calculated, the value may be found by computing theſe ſeparately, and adding the ſums obtained. Thus, the price of ſo many yards, at 9 d. is found, by adding their prices, at 6 d. and 3 d. together.

3d, If the rate be equal to the difference of two eaſy rates, they may be calculated ſeparately, and the leſſer ſubtracted from the greater. Thus, the value of ſo many articles at 11 d. is found, by ſubtracting their value at a penny from their value at a ſhilling. We may ſuppoſe that a ſhilling was paid for each article, and then a penny returned on each.

4th, If the rate be a compoſite number, the value may be found by calculating what it comes to at one of the component parts, and multiplying the ſame by the other.

Case I. "When the rate is an aliquot part of a "pound, divide the quantity by the number which may "be bought for a pound."

Table of the aliquot parts of L. 1.

10 ſhillings	= $\frac{1}{2}$ of L. 1.	1 ſhilling 4 d.	= $\frac{1}{15}$ of L. 1.
6 s. 8 d.	= $\frac{1}{3}$	1 s. 3 d.	= $\frac{1}{16}$
5 s.	= $\frac{1}{4}$	1 s.	= $\frac{1}{20}$
4 s.	= $\frac{1}{5}$	8 d.	= $\frac{1}{30}$
3 s. 4 d.	= $\frac{1}{6}$	6 d.	= $\frac{1}{40}$
2 s. 6 d.	= $\frac{1}{8}$	4 d.	= $\frac{1}{60}$
2 s.	= $\frac{1}{10}$	3 d.	= $\frac{1}{80}$
1 s. 8 d.	= $\frac{1}{12}$	2 d.	= $\frac{1}{120}$

Ex. 1ſt.] What is the value of 7463 yards, at 4 s?

5)7463
L. 1492 12 s.

2d.] What is the value of 1773 yards, at 3 d?

8|0)177|3
L. 22 3 3

In the firſt example we divide by 5, becauſe 4 s. is $\frac{1}{5}$ of a pound; the quotient 1492 ſhows how many pounds they amount to; beſides which there remains three yards at 4 s. and theſe come to 12 s. In the ſecond example, we divide by 80, as directed, and the quotient gives L. 22, and the remainder 13 yards, which at 3 d. comes to 3 s. and 3 d.

This method can only be uſed in calculating for the particular prices ſpecified in the table. The following 6 caſes comprehend all poſſible rates, and will therefore exhibit different methods of ſolving the foregoing queſtions.

Case II. "When the rate conſiſts of ſhillings only, "multiply the quantity by the number of ſhillings, "and divide the product by 20: Or, if the number "of ſhillings be even, multiply by half the number, "and divide the product by 10.

Ex. 1ſt.] 4573 at 13 s.
13
———
13719
4573
———
20)59449
L. 2972 9 s.

2d.] 7543 at 14 s.
7
———
10)52801
L. 5280 2 s.

The learner will eaſily perceive, that the method in which the ſecond example is wrought, muſt give the ſame anſwer as if the quantity had been multiplied by 14, and divided by 20; and, as the diviſion by 10 doubles the laſt figure for ſhillings, and continues all the reſt unchanged for pounds, we may obtain the anſwer at once, by doubling the right-hand figure of the product before we ſet it down.

If the rate be the ſum of two or more aliquot parts of a pound, we may calculate theſe as directed in Caſe I. and add them. If it be any odd number of ſhillings, we may calculate for the even number next lower, and add thereto the value at a ſhilling. If it be 19 s. we may ſubtract the value at a ſhilling, from the value at a pound.

Case III. "When the rate conſiſts of pence only."

Method 1. If the rate be an aliquot part of a ſhilling, divide the quantity accordingly, which gives the anſwer in ſhillings; if not, it may be divided into two or more aliquot parts: calculate theſe ſeparately, and add the values; reduce the anſwer to pounds.

1 penny is $\frac{1}{12}$ of a ſhilling.
2 d. $\frac{1}{6}$ of ditto.
3 d. $\frac{1}{4}$ of ditto.
4 d. $\frac{1}{3}$ of ditto.
6 d. $\frac{1}{2}$ of ditto.
5 d. is the ſum of 4 d. and 1 d. or of 2 d. and 3 d.
7 d. is the ſum of 4 d. and 3 d. or of 6 d. and 1 d.
8 d. is the ſum of 6 d. and 2 d. or the double of 4 d.
9 d. is the ſum of 6 d. and 3 d.
10 d. is the ſum of 6 d. and 4 d.
11 d. is the ſum of 6 d. 3 d. and 2 d.

Ex. 1ſt.] 7423 at 4 d.
———
3)7423
20)2474 4
L. 123 14 4

Here, becauſe 4 d. is one third of a ſhilling, we divide by 3, which gives the price in ſhills. and reduce theſe by diviſion to pounds.

2d.] 9786 at 9 d.
———
At 6 d. = $\frac{1}{2}$ of 1 s. 4893
At 3 d. = $\frac{1}{2}$ of 6 d. 2446 6
——— ——— ———
At 9 d. 7339 6
L. 366 19 6

Here we ſuppoſe, that firſt 6 d. and then 3 d. is paid for each article; half the quantity is the number of ſhillings which they would coſt at 6 d. each. Half of that is the coſt at 3 d. and theſe added and reduced give the anſwer.

3d.] 4856 at 11 d.
———
At 6d. = $\frac{1}{2}$ of 1s. 2428
At 3d. = $\frac{1}{2}$ of 6d. 1214
At 2d. = $\frac{1}{3}$ of 6d. 809 4
——— ———————
11 d. 4451 4
L. 222 11 4

Here we calculate what the articles would coſt at 6 d. at 3 d. and at 2 d. and add the values.

It is ſometimes eaſier to calculate at two rates, whoſe difference is the rate required, and ſubtract the leſſer value from the greater. Thus, the laſt example may be wrought by ſubtracting the value at a penny from the value at a ſhilling. The remainder muſt be the

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lue at 11d.
At 1 s. 4856 s.
At 1 d.=$\frac{1}{12}$ 404 8
At 11d. 4451 4
L. 222 11 4

10d. may be wrought as the difference of 1 s. and 2 d.; and several other rates in like manner.

Meth. 2. *Multiply the quantity by the number of pence, the product is the answer in pence. Reduce it to pounds.*

Meth. 3. *Find the value at a penny by division, and multiply the same by the number of pence.*

CASE IV. "When the rate consists in farthings only, find the value in pence, and reduce it by division to pounds."

Ex. 1st. 37843 at 1 farthing.
4)37843 farth.
12) 9460$\frac{3}{4}$ pence
788 4$\frac{3}{4}$
L. 39 8 4$\frac{3}{4}$

2d. 23754 at $\frac{1}{2}$ d.
2)23754 halfpence
12)11877 pence
989 9
L. 49 9 9

3d. 72564 at $\frac{3}{4}$d
3
4)217692 farth.
1) 54423 pence
4535 3
L. 226 15 3

Or, 72564
At $\frac{1}{2}$d. 3682 d.
At $\frac{1}{4}$d. 18141 d.
12)54423 d.
4535 3
L. 226 15 3

We may also find the amount in twopences, threepences, fourpences, or sixpences, by one division, and reduce these as directed in Case I.

CASE V. "When the rate consists of pence and farthings, find the value of the pence, as directed in Case III. and that of the farthings from the proportion which they bear to the pounds. Add these together, and reduce."

Ex. 1st.] 3287 at 5$\frac{1}{4}$d.
At 4 d.=$\frac{1}{3}$ of 1s. 1095 8
At 1 d.=$\frac{1}{4}$ of 4d. 373 11
At 1 f.=$\frac{1}{4}$ of 1d. 68 5$\frac{3}{4}$
At 5$\frac{1}{4}$ 1438 $\frac{3}{4}$
L. 71 18 $\frac{3}{4}$

2d.] 4573 at 2$\frac{3}{4}$d.
At 2 d.=$\frac{1}{6}$ of 1s. 762 2
At $\frac{1}{2}$d.=$\frac{1}{4}$ of 2d. 190 6$\frac{1}{2}$
At $\frac{1}{4}$d.=$\frac{1}{2}$ of $\frac{1}{2}$d. 85 3$\frac{1}{4}$
At 2$\frac{3}{4}$ 1037 11$\frac{3}{4}$
L. 51 17 11$\frac{3}{4}$

3d.] 2842 at 3$\frac{3}{4}$d.
At 3 d.=$\frac{1}{4}$ of 1s. 710 6
At 3 f.=$\frac{1}{4}$ of 3d. 177 7$\frac{1}{2}$
At 3$\frac{3}{4}$d. 887 1$\frac{1}{2}$
L. 44 8 1$\frac{1}{2}$

4th.] 3572 at 7$\frac{1}{2}$d.
At 6 d.=$\frac{1}{2}$ of 1s. 1386
At 1$\frac{1}{2}$d.=$\frac{1}{4}$ of 6d. 346 6
At 7$\frac{1}{2}$d. 1732 6
L. 87 12 6

It is sometimes best to join some of the pence with the farthings in the calculation. Thus, in Ex. 4. we reckon the value at 6d. and at 3 halfpence, which makes 7$\frac{1}{2}$d.

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If the rate be 1$\frac{1}{2}$d. which is an eighth-part of a shilling, the value is found in shillings, by dividing the quantity by 8.

CASE VI. "When the rate consists of shillings and lower denominations."

Method 1. *Multiply the quantity by the shillings, and find the value of the pence and farthings, if any, from the proportion which they bear to the shillings. Add and reduce.*

Ex. 1st.] 4258 at 17s. 3d.
17
29806
4258
17 s. 72386
3 d.=$\frac{1}{4}$ of 1s. 1064 6
17 s. 3 d. 73450 6
L. 3672 10 6

2d.] 4582 at 12s. 4$\frac{1}{2}$d.
12
12 s. 65784
3 d.=$\frac{1}{4}$ of 1s. 1370 6
1$\frac{1}{2}$d.=$\frac{1}{2}$ of 3d. 685 3
12 s. 4$\frac{1}{2}$d. 67839 9
L. 3391 19 9

Method 2. *Divide the rate into aliquot parts of a pound; calculate the values corresponding to these, as directed in* Case 1. *and add them.*

Ex. 1st.] 3894 at 17 s. 6 d.
10s. =$\frac{1}{2}$ L. 1947
5 =$\frac{1}{4}$ 973 10
2 6 d.=$\frac{1}{8}$ 486 15
17 s. 6 d. L. 3407 5

2d.] 1765 at 9 s. 2 d.
6s. 8d.=$\frac{1}{3}$ L. 588 6 8
2 6 =$\frac{1}{8}$ 220 12 6
9 s. 2 d. 808 19 2

Sometimes part of the value is more readily obtained from a part already found; and sometimes it is easiest to calculate at a higher rate, and subtract the value at the difference.

3d.] 63790 at 5 s. 4 d.
4s. =$\frac{1}{5}$ L. 12758
1s. 4d.=$\frac{1}{3}$ of 4s. 4252 13 4
5 s. 4 d. L. 17010 13 4

4th.] 3664 at 14 s. 9 d.
10s.=$\frac{1}{2}$ L. 1832
5 s. =$\frac{1}{2}$ of 10s. 916
15 s. 2748
3d.=$\frac{1}{20}$ of 5s. 45 16
14s. 9d. L. 2702 4

Method 3. *If the price contain a composite number of pence, we may multiply the value at a penny by the component parts.*

Ex. 5628 at 2 s. 11 d. or 35 d.
12)5628
20) 469
L. 23 9
5
L. 117 5
7
L. 820 15

Case VII. "When the rate consists of pounds and "lower denominations."

Method 1. *Multiply by the pounds, and find the value of the other denominations from the proportion which they bear to the pounds.*

Ex. 1st.] 3592 at L. 3 : 12 : 8.

	3
L. 3	10776
12s $=\frac{1}{5}$ of L. 3	2155 4
8d $=\frac{1}{18}$ of 12s.	119 14 8
L. 3 12 8	L. 13050 18 8

2d.] 543 at L. 2 : 5 : 10½.

	2
L. 2	1086
5 s $=\frac{1}{4}$ of L 1.	135 15
10d $=\frac{1}{6}$ of 5s.	22 12 6
½d $=\frac{1}{20}$ of 10d.	1 2 7½
	L. 1245 10 1½

Method 2. *Reduce the pounds to shillings, and proceed as in* Case VI.

Ex. 1st.] 3592 at L. 3 : 12 : 8		2d.] 3683 at L. 2 : 4 : 11	
72	20		45
7184	72		18415
25144			14732
258624		At 45s.	165735
4d. $=\frac{1}{3}$s. 1197 4		At 1d. $=\frac{1}{12}$s.	307 11
4d. $=\frac{1}{3}$s. 1197 4			
8d. 261018 8		44s. 11d.	165427 1
L. 13050 18 8			L. 8271 7 1

The learner should at first try every calculation more ways than one; which will not only serve the purpose of proving the operation, but will render him expert at discovering the best method of solving each question, and will lead him to invent other methods; for we have not exhausted the subject.

Thus, if the number of articles be 20, each shilling of the rate makes a pound of the amount. If it be 12, each penny of the rate makes a shilling of the amount. If 240, each penny of the rate makes a pound of the amount. If 480, each half-penny makes a pound. If 960, each farthing makes a pound. If the number of articles be a mutiple, or an aliquot part of any of these, the amount is easily calculated. And if it be near to any such number, we may calculate for that number, and add or subtract for the difference.

We have hitherto explained the various methods of computation, when the quantity is a whole number, and in one denomination. It remains to give the proper directions when the quantity contains a fraction, or is expressed in several denominations.

When the quantity contains a fraction, work for the integers by the preceding rules, and for the fraction take proportional parts.

When the quantity is expressed in several denominations and the rate given for the higher; calculate the higher, consider the lower ones as fractions, and work by the last rule.

When the rate is given for the lower denomination, reduce the higher denomination to the lower, and calculate accordingly.

Note 1st. 7 lb. 14 lb. and 21 lb. are aliquot parts of 1 qr.: and 16 lb. is $\frac{1}{7}$ of 1 cwt.; and are therefore easily calculated.

2d. If the price of a dozen be so many shillings, that of an article is as many pence; and if the price of a gross be so many shillings, that of a dozen is as many pence.

3d. If the price of a ton or score be so many pounds, that of 1 cwt. or a single article, is as many shillings.

4th. Though a fraction less than a farthing is of no consequence, and may be rejected, the learner must be careful lest he lose more than a farthing, by rejecting several remainders in the same calculation.

Sect. ii. Deductions *on* Weights, &c.

The full weight of any merchandise, together with that of the cask, box, or other package, in which it is contained, is called the *gross weight*. From this we must make proper deductions, in order to discover the quantity, for which price or duty should be charged, which is called the *nett weight*.

Tare is the allowance for the weight of the package; and this should be ascertained by weighing it before the goods are packed. Sometimes, however, particularly in payment of duty, it is customary to allow so much *per* C. or so much *per* 100 lb. in place of tare.

Tret is an allowance of 4 lb. on 104 granted on currants, and other goods on which their is waste, in order that the weight may answer when the goods are retailed.

Cloff, or Draught, is a further allowance granted on some goods in London, of 2 lb. on every 3 C. to turn the scale in favour of the purchaser. The method of calculating these and the like will appear from the following examples.

Ex. 1st. What is the nett weight of 17 C. 2 q. 14 lb. tare 18 lb. *per* cwt.

	C. q. lb.		C. q. lb.
	17 2 14 gross, or,		17 2 14
			6
16 lb. $=\frac{1}{7}$C.	2 2 2		105 3 —
2lb. $=\frac{1}{8}$ of 16lb	1 7		3
18lb.	2 3 9¼ tare.		317 1
	14 3 4¾ nett.	28)	317¼ lb. C. q. lb.
		4)	11 9¼ (2 3 9¼ t.

In the first method, we add the tare at 16 lb. which is $\frac{1}{7}$ of the gross weight to the tare, at 2lb. which is $\frac{1}{8}$ of the former. In the second, we multiply the gross weight by 18; the tare is 1 lb. for each cwt. of the product, and is reduced by division to higher denominations.

2d.] What is Tret of 158 C. 2 q. 24 lb.?

	C. q. lb.	C. q. lb.
26)	158 2 26.	(6 — 11 Tret.
	156	
	2	
	4	
	10	
	28	
	286	
	280	
	0	

Because tret is always 4 lb. in 104, or 1 lb. in 26, it is obtained by dividing by 26.

3d.]

3d.] What is the closs on 28 C. 2 q.?

```
      C.  q.
      28  2
          2
     ------
   3) 57  (19 lb.
```

This allowance being 2 lb. on every 3 C. might be found by taking ⅓ of the number of C's and multiplying it by 2. It is better to begin with multiplication, for the reason given p. 300. col. 2. par. 1.

19 Sect. iii. Commission, &c.

It is frequently required to calculate allowances on sums of money, at the rate of so many *per* L. 100. Of this kind is Commission, or the allowance due to a factor for buying or selling goods, or transacting any other business; Premium of Insurance, or allowance given for engaging to repay one's losses at sea, or otherwise; Exchange, or the allowance necessary to be added or subtracted for reducing the money of one place to that of another; Premiums on Stocks, or the allowance given for any share of a public stock above the original value. All these and others of a like kind are calculated by the following.

Rule. "Multiply the sum by the rate, and divide the product by 100. If the rate contain a fraction, take proportional parts."

Ex. What is the commission on L. 728, at 2¾ *per cent.*

```
                 728
                   2
                ----
2 per cent.     1456
½                364
¼                182
                ----
       1|00)20|02
              20
             ---
              40
              12
             ---
             4|80
               4 Answ. L. 20——4¾
             ---
             3|20
```

When the rate is given in guineas, which is common in cases of insurance, you may add a twentieth-part to the sum before you calculate. Or you may calculate at an equal number of pounds, and add a twentieth-part to the answer.

When the given sum is an exact number of 10 pounds, the calculation may be done without setting down any figures. Every L. 10, at ½ *per cent.* is a shilling; and at other rates in proportion. Thus, L. 170, at ½ *per cent.* is 17 s.; and, at ¼ *per cent.* 8 s. 6 d.

20 Sect. iv. Interest.

Interest is the allowance given for the use of money by the borrower to the lender. This is computed at so many pounds for each hundred lent for a year, and a like proportion for a greater or a less time. The highest rate is limited by our laws to 5 *per cent.* which is called the *legal interest*; and is due on all debts constituted by bond or bill, which are not paid at the proper term, and is always understood when no other rate is mentioned.

The interest of any sum for a year, at any rate, is found by the method explained in the last section.

The interest of any number of pounds for a year, at 5 *per cent.* is one twentieth-part, or an equal number of shillings. Thus, the interest of L. 34675 for a year is 34675 shillings.

The interest for a day is obtained by dividing the interest for a year, by the number of days in a year. Thus, the interest of L. 34675 for a day is found by dividing 34675 shillings by 365, and comes to 95 shillings.

The interest for any number of days is obtained by multiplying the daily interest by the number of days. Thus, the interest of L. 34675 for 17 days, is 17 times 95 shillings, or 1615 shillings; and this divided by 20, in order to reduce it, comes to L. 80 : 15 s.

It would have served the same purpose, and been easier to multiply at first by 17, the number of days; and, instead of dividing separately by 365, and by 20, to divide at once by 7300, the product of 365 multiplied by 20; and this division may be facilitated by the table inserted p. 298. col. 1.

The following practical rules may be inferred from the foregoing observations.

I. *To calculate interest at 5 per cent.* "Multiply the principal by the number of days, and divide the product by 7300."

II. *To calculate interest at any other rate.* "Find what it comes to at 5 *per cent.* and take a proper proportion of the same for the rate required."

Ex. 1st.] Interest on L. 34675 for 17 days, at 5 *per cent.*

```
           34675
              17
          ------
          242725
          34675
          ------  L.  s.
 73|00)5894|75(80  15
        584
       -----
         5475
           20
       ------
       1095|00
        73
       -----
        365
        365
       -----
          0
```

Ex. 2d. Interest on 304 : 3 : 4 for 8 days, at 4 *per cent.*

```
         L. 304   3   4
                      8
        ------------------  s.  d.
 73|00)2433   6   8 (6   8
        20
      ------
       486|66
       438
      ------
        4866
          12
      ------
        584|00
        584
      ------
          0
```

Practice.

Int. at 5 per cent.	L. —	6	8
Deduce $\frac{1}{5}$	—	1	4
Int. at 4 per cent.	L. —	5	4

When partial payments are made, we proceed in the following manner: Let us suppose a bill of L. 170 was due 12th of August, that L. 54 was paid on the 18th September, L. 56 on the 17th October, and the balance on the 14th November; and let it be required to find how much interest is due.

	L.	Days.		
Aug. 12. L.	170	37	1190	
Sept. 18. pd.	54		510	
				6290
	116	29	1044	
Oct. 17. pd.	56		232	
				3364
	60	28		1680
Nov. 14. pd.	60			
	0		7300)	11334(L. 1 : 11 : $\frac{1}{4}$.

Here we subtract the several payments from the original sum in their order, placing the dates in the margin: and from this it appears that there is interest due on L. 170 from 12th August to 18th September, or L. 110 from 18th September to 17th October, and on L. 60 from 17th October to 14th November. We next compute the number of days in each of these periods, and mark it against the respective sum. Then we multiply each sum by the number of days; reserving a column, when necessary, for the products of the several figures in the multiplier. Lastly, we add these products, and divide their sum by 7300.

Interest on current accounts is calculated nearly in the same manner. For example, let the interest due on the following account be required to 31st July, at 4 per cent?

Dr. Mr A. Baird, his account current with W. Neil, Cr.

1775.					1775.				
Jan. 15. to cash	L. 160				Mar. 22. By cash	L. 50			
Mar. 12. To ditto	36				May 16. By ditto	37			
June 23. To ditto	13	4	6		June 15. By ditto	25	12	6	
July 19. To ditto	26	13	4		28. By ditto	32	5	4	

1775.		L.	s.	d.	Days			
Jan. 1	Dr.	160			50	960		
Mar. 1	Dr.	36				800		Jan. 16
							8960	Feb. 28
	Dr.	196			10		1960	Mar. 31
22.	Cr.	50						Apr. 30
	Dr.	146			55	730		May 31
May 16.	Cr.	37				730		June 30
							8030	July 31
	Dr.	109			30		3270	Days 197
June 15.	Cr.	25	12	6				
	Dr.	83	7	6	8		667	
23.	Dr.	13	4	6				
	Dr.	96	12		5		483	
28.	Cr.	32	5	4				
	Dr.	64	6	8	21	64		
July 19.	Dr.	26	13	4		1287		
							1351	
31.		91			12		1092	
					197	7300	25813	(L. 3 10 $8\frac{1}{2}$ at

Deduce $\frac{1}{5}$ part		14	$1\frac{1}{2}$
Interest at 4 per cent.	L. 2	16	7

Here the sums on either side of the account are introduced according to the order of their dates. Those on the Dr. side are added to the former balance, and those on the Cr. side subtracted. Before we calculate the days, we try if the last sum L. 91, be equal to the balance of the account, which proves the additions and subtractions; and, before multiplying, we try if the sum of the column of days be equal to the number of days, from 15th January to 31st of July.

In the 5th and 6th multiplications, we begin at the pence column, and take in the carriage. In the 7th, instead of multiplying the 6s. 8d. by 21, we add the third-part 21 to the product, because 6s. 8d. is the third of a pound. This is done by marking down the second line 1287, instead of 1280. As the computation on the odd shillings and pence is troublesome, and makes a very small increase of the interest, some neglect them altogether; others add one to the pound, when the shillings exceed 10, and neglect them when below it.

2d.] Required interest on the following account to 31st December, allowing 5 per cent, when the balance is due to J. T. and 4 per cent. when due to N. W.

Dr. Mr J. T. his account current with N. W. Cr.

Dec. 31. To balance	L. 150	April 9. By cash	L. 70
Mar. 12. To cash	120	May 12. By cash	300
June 17. To cash	165	June 3. By cash	240
Sept. 24. To cash	242	Aug. 2. By cash	10
Oct. 9. To cash	178		

1775.		L.	Days			
Dec. 31.	Dr.	150	71	150		
1776.				1050		
Mar. 12.	Dr.	120			10650	
				2160		
	Dr.	270	28	540		
April 9.	Cr.	70			7560	
	Dr.	200	33		6600	
May 12.	Cr.	300				
	Cr.	100	22			2200
June 3.	Cr.	240				
	Cr.	340	14	1360		4760
17.	Dr.	165		340		
	Cr.	175	46	1050		8050
Aug. 2.	Cr.	10		700		
	Cr.	185	53	555		9805
Sept. 24.	Dr.	242		925		
	Dr.	57	15	285		
Oct. 9.	Dr.	178		57		
					855	
Dec. 31.	Dr.	235	83	705		
				1880		
			365		19505	
				7300	45170	24815

Interest due to N. W. at 5 per cent.	L. 6	8	9
Deduce $\frac{1}{5}$ - -		1	5	5
Due to N. W. at 4 per cent.	L. 5	3	4
Due to J. T. at 5 per cent.	3	7	$11\frac{1}{2}$
Balance due to N. W.	L. 1	15	$4\frac{1}{2}$

In

In this account, the balance is sometimes due to the one party, sometimes to the other. At the beginning, there is a balance due to N. W.: and, on the 9th of April, there is L. 200 due him. On the 12th of May, J. T. pays him L. 300, which discharges what he owed, and leaves a balance of L. 100 due him. The balance continues in J. T's favour till the 24th of September, when N. W. pays L. 242. These changes are distinguished by the marks Dr. and Cr. The products are extended in different columns, and divided separately.

When payments are made on constituted debts, at considerable distances of time, it is usual to calculate the interest to the date of each payment, and add it to the principal, and then subtract the payment from the amount.

Ex. A bond for L. 540 was due the 18th Aug. 1772; and there was paid 19th March 1773, L. 50; and 19th December 1773, L. 25; and 23d September 1774 L. 25; and 18th August 1775 L. 110. Required the interest and balance due on the 11th November 1775?

A bond due 13th August 1772		L. 540		
Interest to 19th March 1773, 218 days	L. 16 2 6	16	2	6
		L. 556	2	6
Paid 19th March 1773		50		
Balance due 19th March 1773		L. 506	2	6
Interest to 19th December 1773, 275 days	19 1 2	19	1	2
		L. 525	3	8
Paid 19th December 1773		25		
Balance due 19th December 1773		L. 500	3	8
Interest to 23d September 1774, 278 days	19 0 9	19	0	9
		L. 519	4	5
Paid 23d September 1774		25		
Balance due 23d September 1774		L. 494	4	5
Interest to 18th August 1775, 329 days	22 5 3	22	5	3
		L. 516	9	8
Paid 18th August 1775		110		
Balance due 18th August 1775		L. 406	9	8
Interest to 11th November 1775, 85 days	4 14 6	4	14	6
Balance due 11th November 1775		L. 411	4	2
Amount of the interest	L. 81 4 2			

21 ## Chap. VIII. VULGAR FRACTIONS.

In order to understand the nature of vulgar fractions, we must suppose unity (or the number 1) divided into several equal parts. One or more of these parts is called a *fraction*, and is represented by placing one number in a small character above a line, and another under it: For example, two-fifth parts is written thus, $\frac{2}{5}$. The number under the line (5) shows how many parts unity is divided into, and is called the *denominator*. The number above the line (2) shews how many of these parts are represented, and is called the *numerator*.

It follows from the manner of representing fractions, that, when the numerator is increased, the value of the fraction becomes greater; but, when the denominator is increased, the value becomes less. Hence we may infer, that, if the numerator and denominator be both increased, or both diminished, in the same proportion, the value is not altered; and therefore, if we multiply both by any number whatever, or divide them by any number which measures both, we shall obtain other fractions of equal value. Thus, every fraction may be expressed in a variety of forms, which have all the same signification.

A fraction annexed to an integer, or whole number, makes a mixed number. For example, five and two third-parts, or $5\frac{2}{3}$. A fraction whose numerator is greater than its denominator is called an *improper fraction*. For example, seventeen third-parts, or $\frac{17}{3}$. Fractions of this kind are greater than unity. Mixed numbers may be represented in the form of improper fractions, and improper fractions may be reduced to mixed numbers, and sometimes to integers. As fractions whether proper or improper, may be represented in different forms, we must explain the method of reducing them from one form to another, before we consider the other operations.

Problem I. "To reduce mixed numbers to improper fractions; Multiply the integer by the denominator of the fraction, and to the product add the numerator. The sum is the numerator of the improper fraction sought, and is placed above the given denominator." *Ex.* $5\frac{2}{3}=\frac{17}{3}$

5 integer.
3 denominator.
—
15 product
2 numerator given.
—
17 numerator sought.

Because one is equal to two halves, or 3 third parts, or 4 quarters, and every integer is equal to twice as many halves, or four times as many quarters, and so on; therefore, every integer may be expressed in the form of an improper fraction, having any assigned denominator: The numerator is obtained by multiplying the integer into the denominator. Hence the reason of the foregoing rule is evident. 5, reduced to an improper fraction, whose denominator is 3, makes $\frac{15}{3}$, and this added to $\frac{2}{3}$ amounts to $\frac{17}{3}$.

Problem II. "To reduce improper fractions to whole or mixed numbers: Divide the numerator by the denominator."

Ex. $\frac{112}{17}=6\frac{10}{17}$

17)112($6\frac{10}{17}$
102
——
10

1. $\frac{3248}{16}$ 5. $\frac{365}{15}$
2. $\frac{342}{12}$ 6. $\frac{7394}{37}$
3. $\frac{7536}{27}$ 7. $\frac{8642}{93}$
4. $\frac{15764}{378}$ 8. $\frac{4362}{218}$

This problem is the converse of the former, and the reason may be illustrated in the same manner.

Problem III. "To reduce fractions to lower terms. Divide both numerator and denominator by any number which measures both, and place the quotients in the form of a fraction."

Example. $\frac{135}{360} = \frac{27}{72} = \frac{3}{8}$

Here we observe that 135 and 360 are both measured by 5, and the quotients form $\frac{27}{72}$, which is a fraction of the same value as $\frac{135}{360}$ in lower terms. Again, 27 and 72 are both measured by 9, and the quotients form $\frac{3}{8}$, which is still of equal value, and in lower terms.

It is generally sufficient, in practice, to divide by such measures as are found to answer on inspection, or by the rules given p. 396. col 2. But if it be required to reduce a fraction to the lowest possible terms, we must divide

Vulgar Fractions.

vide the numerator and denominator by the greatest number which measures both. What number this is may not be obvious, but will always be found by the following rule.

To find the greatest common measure of two numbers, divide the greater by the lesser, and the divisor by the remainder continually, till nothing remain; the last divisor is the greatest common measure.

Example. Required the greatest number which measures 475 and 589?

```
475)589(1
    475
    ———
    114)475(4
        456
        ———
         19)114(6
            114
            ———
              0
```

Here we divide 589 by 475, and the remainder is 114; then we divide 475 by 114, and the remainder is 19; then we divide 114 by 19, and there is no remainder: from which we infer; that 19 the last divisor, is the greatest common measure.

To explain the reason of this, we must observe, that any number which measures two others, will also measure their sum, and their difference, and will measure any multiple of either. In the foregoing example, any number which measures 589, and 475, will measure their difference 114; and will measure 456, which is a multiple of 114; and any number which measures 475, and 476, will also measure their difference 19. Consequently, no number greater than 19 can measure 589 and 475. Again, 19 will measure them both, for it measures 114, and therefore measures 456, which is a multiple of 114, and 475, which is just 19 more than 456; and, because it measures 475 and 114, it will measure their sum 589. To reduce $\frac{475}{589}$ to the lowest possible terms, we divide both numbers by 19, and it comes to $\frac{25}{31}$.

If there be no common measure greater than 1, the fraction is already in the lowest terms.

If the greatest common measure of 3 numbers be required, we find the greatest measure of the two first, and then the greatest measure of that number, and the third. If there be no numbers, we proceed in the same manner.

Problem IV. "To reduce fractions to others of "equal value that have the same denominator: 1st. "Multiply the numerator of each fraction by all the "denominators except its own. The products are numerators to the respective fractions sought." 2d. "Multiply all the denominators into each other; the "product is the common denominator."

Ex. $\frac{4}{5}$ and $\frac{7}{9}$ and $\frac{3}{8}=\frac{288}{360}$ and $\frac{280}{360}$ and $\frac{135}{360}$.

$4\times9\times8=288$ first numerator.

$7\times5\times8=280$ second numerator.

$3\times5\times9=135$ third numerator.

$5\times9\times8=360$ common denominator.

Here we multiply 4, the numerator of the first fraction, by 9 and 3 the denominators of the two others; and the product 288 is the numerator of the fraction sought, equivalent to the first. The other numerators are found in like manner, and the common denominator 360, is obtained by multiplying the given denominators 5, 9, 8, into each other. In the course of the whole operation, the numerators and denominators of each fraction are multiplied by the same number, and therefore their value is not altered.

The fractions thus obtained may be reduced to lower terms, if the several numerators and denominators have a common measure greater than unity. Or, after arranging the number for multiplication, as is done above, if the same number occur in each rank, we may dash them out and neglect them; and, if numbers which have a common measure occur in each, we may dash them out and use the quotients in their stead; or any number which is a multiple of all the given denominators, may be used as a common denominator. Sometimes a number of this kind will occur on inspection, and the new numerators are found by multiplying the given ones by the common denominator, and dividing the products by the respective given denominators.

If the articles given for any operation be mixed numbers, they are reduced to improper fractions by problem I. If the answer obtained be an improper fraction, it is reduced to a mixed number by problem II. And, it is convenient to reduce fractions to lower terms, when it can be be done, by problem III. which makes their value better apprehended, and facilitates any following operation. The reduction of fractions to the same denominator by problem IV. is necessary to prepare them for addition or subtraction, but not for multiplication or division.

1. Addition *of* Vulgar Fractions. 22

Rule. "Reduce them, if necessary, to a common "denominator; add the numerators, and place the "sum above the denominator."

Ex. 1st.] $\frac{3}{5}+\frac{2}{9}=\frac{27}{45}+\frac{10}{45}$ by problem IV. $=\frac{37}{45}$

2d.] $\frac{5}{7}+\frac{8}{9}+\frac{9}{10}=\frac{450}{630}+\frac{560}{630}+\frac{567}{630}=\frac{1577}{630}$ by problem II. $=3\frac{317}{630}$

The numerators of fractions that have the same denominator signify like parts; and the reason for adding them is equally obvious, as that for adding shillings or any other inferior denomination.

Mixed numbers may be added, by annexing the sum of the fractions to the sum of the integers. If the former be a mixed number, its integer is added to the other integers.

2. Subtraction *of* Vulgar Fractions. 23

Rule. "Reduce the fractions to a common deno"minator; subtract the numerator of the subtrahend "from the numerator of the minuend, and place the "remainder above the denominator."

Ex. Subtract $\frac{2}{7}$ from $\frac{5}{12}$ remainder $\frac{11}{84}$.

$\left.\begin{array}{l}\frac{5}{12}=\frac{35}{84}\\ \frac{2}{7}=\frac{24}{84}\end{array}\right\}$ by Prob. IV.

from 35
take 24
——
rem. 11

To subtract a fraction from an integer: subtract the numerator from the denominator, and place the remainder above the denominator; prefix to this the integer diminished by unity.

Ex. Subtract $\frac{3}{5}$ from 12 remainder $11\frac{2}{5}$

To subtract mixed numbers, proceed with the fractions by the foregoing rule, and with the integers in the common method. If the numerator of the fraction in the subtrahend exceed that in the minuend, borrow the value of the denominator, and repay it by adding 1 to the unit-place of the subtrahend.

Ex.

Ex. Subtract $145\frac{7}{9}$ from $248\frac{3}{5}$

$$\left.\begin{array}{l}\frac{3}{5}=\frac{27}{45}\\ \frac{7}{9}=\frac{35}{45}\end{array}\right\}\text{ by Prob. IV.}\qquad \begin{array}{r}248\frac{27}{45}\\ 145\frac{35}{45}\\ \hline 102\frac{37}{45}\end{array}\qquad \begin{array}{c}27\\45\\72\\35\\37\end{array}$$

Here, because 27 the numerator of the fraction in the minuend is less than 35, the numerator of the subtrahend, we borrow 45 the denominator; 27 and 45 make 72, from which we subtract 35, and obtain 37 for the numerator of the fraction in the remainder, and we repay what was borrowed, by adding 1 to 5 in the unit-place of the subtrahend.

The reason of the operations in adding or subtracting fractions will be fully understood, if we place the numerators of the fractions in a column like a lower denomination, and add or subtract them as integers, carrying or borrowing according to the value of the higher denomination.

24 3. Multiplication *of* Vulgar Fractions.

Rule. "Multiply the numerators of the factors "together for the numerator of the product, and the "denominators together for the denominator of the "product."

Ex. 1st.] $\frac{2}{3}\times\frac{5}{7}=\frac{10}{21}$
$2\times5=10$ num.
$3\times7=21$ den.

2d.] $8\frac{2}{5}\times7\frac{3}{4}=\frac{1302}{20}=65\frac{2}{20}$
$8\frac{2}{5}=\frac{42}{5}$ by prob. I.
$7\frac{3}{4}=\frac{31}{4}$ by ditto.
$42\times31=1302$
$5\times\ 4=\ \ 20$.

To multiply $\frac{5}{7}$ by $\frac{2}{3}$ is the same, as to find what two third-parts of $\frac{5}{7}$ comes to; if one-third part only had been required, it would have been obtained by multiplying the denominator 7 by 3, because the value of fractions is lessened when their denominators are increased; and this comes to $\frac{5}{21}$; and, because two-thirds were required, we must double that fraction, which is done by multiplying the numerator by 2, and comes to $\frac{10}{21}$. Hence we infer, that fractions of fractions, or compound fractions, such as $\frac{2}{7}$ of $\frac{3}{5}$ are reduced to simple ones by multiplication. The same method is followed when the compound fraction is expressed in three parts or more.

If a number be multiplied by any integer, its value is increased: If it be multiplied by 1, or taken one time, it undergoes no alteration. If it be multiplied by a proper fraction, or taken from one-half, two-thirds, or the like, its value is diminished, and the product is less than the number multiplied.

The foregoing rule extends to every case, when there are fractions in either factor. For mixed numbers may be reduced to improper fractions, as is done in Ex. 2d.; and integers may be written, or understood to be written in the form of fractions whose numerator is 1. It will be convenient, however, to give some further directions for proceeding, when one of the factors is an integer, or when one or both are mixed numbers.

1st. To multiply an integer by a fraction, multiply it by the numerator, and divide the product by the denominator. *Ex.* $3756\times\frac{3}{5}=2253\frac{3}{5}$

$$\begin{array}{r}3756\\ 3\\ \hline 5)11268(2253\frac{3}{5}\end{array}$$

2d. To multiply an integer by a mixed number, we multiply it first by the integer, and then by the fraction, and add the products.

Ex. $148\times5\frac{3}{4}=793\frac{1}{2}$

$$\begin{array}{l}138\times5=690\\ 138\times\ \frac{3}{4}\\ \quad\ \ 3\\ \hline 4)414(\quad 103\frac{1}{2}\\ \hline \qquad\qquad 793\frac{1}{2}\end{array}$$

3d. To multiply a mixed number by a fraction, we may multiply the integer by the fraction, and the two fractions together, and add the products.

Ex. $15\frac{3}{8}\times\frac{2}{9}=3\frac{5}{12}$

$$\begin{array}{l}15\times\frac{2}{9}=3\frac{3}{9}=3\frac{4}{12}\\ \frac{3}{8}\times\frac{2}{9}=\frac{6}{72}=\frac{1}{12}\\ \hline \qquad\qquad 3\frac{5}{12}\end{array}$$

4th. When both factors are mixed numbers, we may multiply each part of the multiplicand first by the integers of the multiplier, and then by the fraction, and add the four products.

Ex. $8\frac{2}{5}$ by $7\frac{3}{4}$

$$\begin{array}{lll}8\times7= & 56 & \\ 8\times\frac{3}{4}=\frac{24}{4}= & 6 & \text{by prob. II.}\\ \frac{2}{5}\times7=\frac{14}{5}=2\frac{4}{5}= & 2\frac{16}{20} & \\ \frac{2}{5}\times\frac{3}{4}= & \frac{6}{20} & \\ \hline \end{array}$$

product $65\frac{2}{20}$ as before.

4. Division *of* Vulgar Fractions. 25

Rule I. "Multiply the numerator of the dividend by the denominator of the divisor. The product is the numerator of the quotient."

II. "Multiply the denominator of the dividend by "the numerator of the divisor. The product is the "denominator of the quotient."

Ex. Divide $\frac{2}{5}$ by $\frac{7}{9}$. Quotient $\frac{18}{35}$
$2\times9=18$
$5\times7=35$

To explain the reason of this operation, let us suppose it required to divide $\frac{5}{7}$ by 7, or to take one-seventh part of that fraction. This is obtained by multiplying the denominator by 7; for the value of fractions is diminished by increasing their denominators, and comes to $\frac{2}{35}$. Again, because $\frac{7}{9}$ is nine times less than seven, the quotient of any number divided by $\frac{7}{9}$ will be nine times greater than the quotient of the same number divided by 7. Therefore we multiply $\frac{2}{35}$ by 9, and obtain $\frac{18}{35}$.

If the divisor and dividend have the same denominator, it is sufficient to divide the numerators.

Ex. $\frac{12}{17}$ divided by $\frac{3}{17}$ quotes 4.

The quotient of any number divided by a proper fraction is greater than the dividend. It is obvious, that any integer contains more halves, more third-parts, and the like, than it contains units; and, if an integer and fraction be divided alike, the quotients will have the same proportion to the numbers divided; but the value of an integer is increased when the divisor is a proper fraction; therefore, the value of a fraction in the like case is increased also.

The foregoing rule may be extended to every case, by reducing integers and mixed numbers to the form of improper fractions. We shall add some directions for shortening the operation when integers and mixed numbers are concerned.

1st. When the dividend is an integer, multiply it

Vulgar Fractions.

by the denominator of the divisor, and divide the product by the numerator.

Ex. Divide 368 by $\frac{5}{7}$

$$\begin{array}{l} \quad 7 \\ \hline 5)2576\ (515\tfrac{1}{5} \text{ quotient.} \end{array}$$

2d. When the divisor is an integer, and the dividend a fraction, multiply the denominator by the divisor, and place the product under the numerator.

Ex. Divide $\frac{3}{8}$ by 5 quotient $\frac{3}{40}$

$8 \times 5 = 40$

3d. When the divisor is an integer, and the dividend a mixed number, divide the integer, and annex the fraction to the remainder; then reduce the mixed number thus formed, to an improper fraction, and multiply its denominator by the divisor.

Ex. To divide $576\frac{4}{11}$ by 7 quotient $82\frac{26}{77}$

$$\begin{array}{l} 7)\ 576\ (82 \\ \quad 56 \\ \hline \quad\ 16 \\ \quad\ 14 \\ \hline 2\tfrac{4}{11} = \tfrac{26}{11} \\ 11 \times 7 = 77 \end{array}$$

Here we divide 576 by 7, the quotient is 82, and the remainder 2, to which we annex the fraction $\frac{4}{11}$; and reduce $2\frac{4}{11}$ to an improper fraction $\frac{26}{11}$, and multiply its denominator by 7, which gives $\frac{26}{77}$.

Hitherto we have considered the fractions as abstract numbers, and laid down the necessary rules accordingly. We now proceed to apply these to practice. Shillings and pence may be considered as fractions of pounds, and lower denominations of any kind as fractions of higher; and any operation, where different denominations occur, may be wrought by expressing the lower ones in the form of vulgar fractions, and proceeding by the foregoing rules. For this purpose, the two following problems are necessary.

Problem V. "To reduce lower denominations to "fractions of higher, place the given number for the "numerator, and the value of the higher for the de-"nominator."

Examples.

1. Reduce 7 d. to the fraction of a shilling. Ans. $\frac{7}{12}$
2. Reduce 7 d. to a fraction of a pound. Ans. $\frac{7}{240}$
3. Reduce 15 s. 7 d. to a fraction of a pound. Ans. $\frac{187}{240}$.

Problem VI. "To value fractions of higher deno-"minations, multiply the numerator by the value of "the given denomination, and divide the product by "the denominator; if there be a remainder, multi-"ply it by the value of the next denomination, and "continue the division."

Ex. 1st.] Required the value of $\frac{17}{60}$ of L 1.

$$\begin{array}{lll} \quad 17 & & \\ \quad 20 & & \\ \hline & s. & d. \\ 60)340(& 5 & 8 \\ \quad 300 & & \\ \hline \quad\ 40 & & \\ \quad\ 12 & & \\ \hline 60)480 & & \\ \quad 480 & & \\ \hline \quad\ 0 & & \end{array}$$

2d.] Required the value of $\frac{8}{9}$ of 1 Cwt.

$$\begin{array}{lll} \quad 8 & & \\ \quad 4 & & \\ \hline & qrs. & lb. \\ 9)32(& 3 & 15\tfrac{5}{9} \\ \quad 27 & & \\ \hline \quad\ 5 & & \\ \quad 28 & & \\ \hline 9)140 & & \\ \quad\ 9 & & \\ \hline \quad 50 & & \\ \quad 45 & & \\ \hline \quad\ 5 & & \end{array}$$

In the first example, we multiply the numerator 17 by 20, the number of shillings in a pound, and divide the product 340 by 60, the denominator of the fraction, and obtain a quotient of 5 shillings; then we multiply the remainder 40 by 12, the number of pence in a shilling, which produces 480, which divided by 60 quotes 8 d. without a remainder. In the second example we proceed in the same manner; but as there is a remainder, the quotient is completed by a fraction.

Decimal Fractions.

Sometimes the value of the fraction does not amount to a unit of the lowest denomination; but it may be reduced to a fraction of that or any other denomination, by multiplying the numerator according to the value of the places. Thus $\frac{1}{1289}$ of a pound is equal to $\frac{20}{1289}$ of a shilling, or $\frac{240}{1289}$ of a penny, $\frac{960}{1289}$ of a farthing.

Chap. IX. DECIMAL FRACTIONS.

Sect. i. Notation *and* Reduction. 26

The arithmetic of vulgar fractions is tedious, and even intricate to beginners. The difficulty arises chiefly from the variety of denominators; for when numbers are divided into different kinds of parts, they cannot be easily compared. This consideration gave rise to the invention of decimal fractions, where the units are divided into like parts, and the divisions and subdivisions are regulated by the same scale which is used in the Arithmetic of Integers. The first figure of a decimal fraction signifies tenth parts, the next hundredth parts, the next thousandth parts, and so on: and the columns may be titled accordingly. Decimals are distinguished by a point, which separates them from integers, if any be prefixed.

The use of cyphers in decimals, as well as in integers, is to bring the significant figures to their proper places, on which their value depends. As cyphers, when placed on the left hand of an integer, have no signification, but when placed on the right hand, increase the value ten times each; so cyphers, when placed on the right hand of a decimal, have no signification; but when placed on the left hand diminish the value ten times each.

The notation and numeration of decimals will be obvious from the following examples:

4.7	signifies Four, and seventh tenth-parts.
.47	Four tenth-parts, and seven hundredth-parts, or 47 hundredth-parts.
.047	Four hundredth-parts, and seven thousandth-parts, or 47 thousandth-parts.
.407	Four tenth-parts, and seven thousandth-parts, or 407 thousandth-parts.
4.07	Four, and seven hundredth-parts.
4.007	Four, and seven thousandth-parts.

The column next the decimal point is sometimes called *decimal primes*, the next *decimal seconds*; and so on.

To reduce vulgar fractions to decimal ones: "An-"nex a cypher to the numerator, and divide it by "the denominator, annexing a cypher continually "to the remainder."

Ex.

Decimal Fractions.

Ex. 1st.] $\frac{12}{75}$=.16 2d.] $\frac{5}{64}$=.078125 3d.] $\frac{2}{3}$=.666.

```
75)120(16      64)500(078125     3)20(666.
   75             448              18
   ---            ---              --
   450            520             *20
   450            512              18
   ---            ---              --
    0              80              20
                   64              18
                   --              --
                  160              20
                  128
                  ---
                  320
                  320
                  ---
```

4th.] $\frac{5}{6}$=.833 5th.] $\frac{7}{27}$=.259 6th.] $\frac{7}{22}$=.3, 18, 18,

```
6)50(83      27)70(259      22)70(31818
  48            54             66
  --            --             --
 *20           160            *40
  18           135             22
  --           ---             --
  20           250            180
  18           243            176
  --           ---            ---
  20           *70            *40
                               22
                               --
                              180
```

The reason of this operation will be evident, if we consider that the numerator of a vulgar fraction is understood to be divided by the denominator; and this division is actually performed when it is reduced to a decimal.

In like manner, when there is a remainder left in division, we may extend the quotient to a decimal, instead of completing it by a vulgar fraction, as in the following example.

```
     25)646(25 21/25 or 25.84.
        50
        ---
        126
        125
        ---
Rem.   21.0
       200
       ---
        100
        100
        ---
          0
```

From the foregoing examples, we may distinguish the several kinds of decimals. Some vulgar fractions may be reduced exactly to decimals, as Ex. 1st and 2d, and are called *terminate* or *finite decimals*. Others cannot be exactly reduced, because the division always leaves a remainder; but, by continuing the division, we will perceive how the decimal may be extended to any length whatever. These are called *infinite decimals*. If the same figure continually returns, as in Ex. 3d and 4th, they are called *repeaters*. If two or more figures return in their order, they are called *circulates*. If this regular succession go on from the beginning, they are called *pure repeaters*, or *circulates*, as Ex. 3d and 5th. If otherwise, as Ex. 4 and 6th, they are mixed repeaters or circulates, and the figures prefixed to those in regular succession are called the *finite part*. Repeating figures are generally distinguished by a dot, and cirulates by a comma, or other mark, at the beginning and end of the circle; and the beginning of a repeater or circulate is pointed out in the division by an asterisk.

Decimal Fractions.

Lower denominations may be considered as fractions of higher ones, and reduced to decimals accordingly. We may proceed by the following rule, which is the same, in effect, as the former.

To reduce lower denominations to decimals of higher: "Annex a cypher to the lower denomination, and divide it by the value of the higher. When there are several denominations, begin at the lowest, and reduce them in their order."

Ex. To reduce 5 cwt. 2 qr. 21 lb. to a decimal of a ton?

```
28)210(.75     4)2.75(.6875     20)5.6874(.284375
   196            24                40
   ---            --                --
   140            35               168
   140            32               160
   ---            --               ---
    0             30                87
                  28                80
                  --                --
                  20                75
                  20                60
                  --                --
                   0               150
                                   140
                                   ---
                                   100
                                   100
                                   ---
                                     0
```

Here, in order to reduce 21 lb. to a decimal of 1 qr. we annex a cypher, and divide by 28, the value of 1 qr. This gives .75. Then we reduce 2.75 qrs. to a decimal of 1 cwt. by dividing by 4, the value of 1 cwt. and it comes to .6875. Lastly, 5.6875 cwt. is reduced to a decimal of a ton by dividing by 20, and comes to .284375.

To value a decimal fraction: "Multiply it by the value of the denomination, and cut off as many decimal places from the product as there are in the multiplicand. The rest are integers of the lower denomination.

Example. What is the value of .425 of L. 1?

```
      .425
        20
     -----
sh. 8.500
        6
     -----
 d. 3.000
```

Sect. ii. ARITHMETIC *of* TERMINATE DECIMALS.

THE value of decimal places decrease like that of integers, ten of the lower place in either being equal to one of the next higher; and the same holds in passing from decimals to integers. Therefore, all the operations are performed in the same way with decimals, whether

Decimal Fractions.

whether placed by themselves or annexed to integers, as with pure integers. The only peculiarity lies in the arrangement and pointing of the decimals.

In addition and subtraction, "Arrange units under "units, tenth-parts under tenth-parts, and proceed as "in integers."

```
  32.035      from 13.348     and 12.248
 116.374      take  9.2993        10.6752
 160.63            ------         -------
  12.3645           4.0487         1.5728
 --------
 321.4035
```

In Multiplication, "Allow as many decimal places "in the product as there are in both factors. If the "product has not so many places, supply them by "prefixing cyphers on the left hand."

```
Ex. 1st.) 1.37    2d.] 43.75    3d.] .1572
          1.8            48           .12
          ----        -----        ------
          1096        35000        .01864
          137         17500
          -----       -------
          2.466       21.0000
```

The reason of this rule may be explained, by observing, that the value of the product depends on the value of the factors; and since each decimal place in either factor diminishes its value ten times, it must equally diminish the value of the product.

To multiply decimals by 10, move the decimal point one place to the right; to multiply by 100, 1000, or the like, move it as many places to the right as there are cyphers in the multiplier.

In division, "Point the quotient so that there may "be an equal number of decimal places in the divi-"dend as in the divisor and quotient together."

Therefore, if there be the same decimal places in the divisor and dividend, there will be as many in the quotient.

If there be more in the dividend, the quotient will have as many as the dividend has more than the divisor.

If there be more in the divisor, we must annex (or suppose annexed) as many cyphers to the dividend as may complete the number in the divisor, and all the figures of the quotient are integers.

If the division leave a remainder, the quotient may be extended to more decimal places; but these are not regarded in fixing the decimal point.

The reason for fixing the decimal point, as directed, may be inferred from the rule followed in multiplication. The quotient multiplied by the divisor produces the dividend; and therefore the number of decimal places in the dividend is equal to those in the divisor and quotient together.

The first figure of the quotient is always at the same distance from the decimal point, and on the same side as the figure of the dividend, which stands above the unit place of the first product. This also takes place in integers; and the reason is the same in both.

It was formerly observed, that numbers were diminished when multiplied by proper fractions, and increased when divided by the same. Thus, multiplication by fractions corresponds with division by integers; and division by fractions with multiplication by integers; when we multiply by $\frac{1}{2}$ or .5, we obtain the same answers as when we divide by 2, and every integer has a correspondent decimal, which may be called its *reciprocal*. Multiplication by that decimal supplies the place of division by the integer, and division supplies the place of multiplication.

To find the reciprocal of any number, divide 1 with cyphers annexed by that number.

Ex. Required the reciprocal of 625.

```
625)1.000(.0016
     625
     ----
     3750
     3750
     ----
        0
```

The product of any number multiplied by .0016 is the same as the quotient divided by 625. *Example.*

```
625)9375(15          9375
    625              .0016
    ----             -----
    3125             56250
    3125             9375
    ----             -------
       0             15.0000
```

Because .0016 is $\frac{1}{625}$ of unity, any number multiplied by that fraction will be diminished 625 times. For a like reason, the quotient of any number divided by .0016, will be equal to the product of the same multiplied by 625. *Example.*

```
.0016)516.0000(322500        516
       48 ....               625
       --                    ----
        36                   2580
        32                  1032
        --                 3096
         40                ------
         32                322500
         --
          80
          80
          --
           0
```

Sect. iii. Approximate Decimals. 28

It has been shown that some decimals, though extended to any length, are never complete: and others which terminate at last, sometimes consist of so many places, that it would be difficult in practice to extend them fully. In these cases, we may extend the decimal to three, four, or more places, according to the nature of the articles, and the degree of accuracy required, and reject the rest of it as inconsiderable. In this manner we may perform any operation with ease by the common rules, and the answers we obtain are sufficiently exact for any purpose in business. Decimals thus restricted are called *approximates*.

Shillings, pence, and farthings, may be easily reduced to decimals of three places, by the following rule. Take half the shillings for the first decimal place, and the number of farthings increased by one, if it amount to 24, or upwards; by two, if it amount to 48 or upwards; and by three, if it amounts to 72 or upwards, for the two next places.

The reason of this is, that 20 shillings make a pound, two shillings is the tenth part of a pound; and therefore

fore half the number of shillings makes the first decimal place. If there were 50 farthings in a shilling, or 1000 in a pound, the units of the farthings in the remainder would be thousandth-parts, and the tens would be hundredth-parts, and so would give the two next decimal places; but because there are only 48 farthings in a shilling, or 960 in a pound, every farthing is a little more than the thousandth-part of a pound; and since 24 farthings make 25 thousandth-parts, allowance is made for that excess by adding one for every 24 farthings, as directed.

If the number of farthings be 24, 48, or 72, and consequently the second and third decimal places 25, 50, and 75, they are exactly right; otherwise they are not quite complete, since there should be an allowance of $\frac{1}{24}$ not only for 24, 48, and 72 farthings, but for every other single farthing. They may be completed by the following rule: Multiply the second and third decimal places, or their excess above 25, 50, 75 by 4. If the product amount to 24 or upwards, add 1; if 48, add 2; if 72, add 3. By this operation we obtain two decimal places more; and by continuing the same operation, we may extend the decimal till it terminate in 25, 50, 75, or in a repeater.

Decimals of sterling money of three places may easily be reduced to shillings, pence, and farthings, by the following rule. Double the first decimal place, and if the second be 5 or upwards, add 1 thereto for shillings. Then divide the second and third decimal places, or their excess above 50, by 4, first deducing 1, if it amount to 25, or upwards: the quotient is pence, and the remainder farthings.

As this rule is the converse of the former one, the reason of the one may be inferred from that of the other. The value obtained by it, unless the decimal terminate in 25, 50, or 75, is a little more than the true value; for there should be a deduction not only of 1 for 25, but a like deduction of $\frac{1}{25}$ on the remaining figures of these places.

We proceed to give some examples of the arithmetic of approximates, and subjoin any necessary observations.

Addition.

Cwt.	qrs.	lb.	
3	2	14	= 3.625
2	3	22	= 2.94642
3	3	19	= 3.91964
4	1	25	= 4.47321
14	3	24	14.96427

Subtraction.

Cwt.	qrs.	lb.	
3	2	2	= 3.51785
1	1	19	= 1.41964
2	—	9	2.09821

If we value the sum of the approximates, it will fall a little short of the sum of the articles, because the decimals are not complete.

Some add one to the last decimal place of the approximate, when the following figure would have been 5, or upwards. Thus the full decimal of 3 qrs. 22 lb. is .946,428571, and therefore .94643 is nearer to it than .94642. Approximates, thus regulated, will in general give exacter answers, and sometimes above the true one, sometimes below it.

The mark + signifies that the approximate is less than the exact decimal, or requires something to be added. The mark — signifies that it is greater, or requires something to be subtracted.

Multiplication.

	Meth. 2d.]	Meth. 3d.]
8278 +	8278	8278
2153 +	2153	3512
24834	16556|	16556
41390	827|8	827
8278	413|90	413
16556	24|834	24
1782|2534	1782|2534	1782

Here the four last places are quite uncertain. The right-hand figure of each particular product is obtained by multiplying 8 into the figures of the multiplier; but if the multiplicand had been extended, the carriage from the right-hand place would have been taken in; consequently the right-hand place of each particular product, and the four places of the total product, which depend on these, are quite uncertain. Since part of the operation, therefore, is useless, we may omit it; and, for this purpose, it will be convenient to begin (as in p. 296. col. 1. *fifth* variety) at the highest place of the multiplier. We may perceive that all the figures on the right hand of the line in Method 2. serve no purpose, and may be left out, if we only multiply the figures of the multiplicand, whose products are placed on the right hand of the line. This is readily done by inverting the multiplier in method 3. and beginning each product with the multiplication of that figure which stands above the figure of the multiplier that produces it, and including the carriage from the right-hand place.

If both factors be approximates, there are as many uncertain places, at least in the product, as in the longest factor. If only one be an approximate, there are as many uncertain places as there are figures in that factor, and sometimes a place or two more, which might be affected by the carriage. Hence we may infer, how far it is necessary to extend the approximates, in order to obtain the requisite number of certain places in the product.

Division.

.3724—)798|64327+(2144	or $3\dot{7}\dot{2}\dot{4}$)79864327(2144
744|8	7448
53|84	538
37|24	372
16|602	166
14|896	148
1|7063	18
1|4892	14
2171	4

Here all the figures on the right hand of the line are uncertain; for the right-hand figure of the first product 7448 might be altered by the carriage, if the divisor were extended; and all the remainders and dividuals that follow are thereby rendered uncertain. We may omit these useless figures; for which purpose, we dash a figure on the right hand of the divisor at each step, and neglect it when we multiply by the figure of the quotient next obtained: but we include the carriage. The operation, and the reason of it, will appear clear, by comparing the operation at large, and contracted, in the above example.

Chap. X. INTERMINATE DECIMALS.

29 ### Sect. i. Reduction of Interminate Decimals.

As the arithmetic of interminate decimals, otherwise called the *arithmetic of infinites*, is facilitated by comparing them with vulgar fractions, it will be proper to inquire what vulgar fractions produce the several kinds of decimals, terminate or interminate, repeaters or circulates, pure or mixed. And, first, we may observe, that vulgar fractions, which have the same denominator, produce decimals of the same kind. If the decimals corresponding to the numerator 1 be known, all others are obtained by multiplying these into any given numerator, and always retain the same form, providing the vulgar fraction be in its lowest terms.

Thus, the decimal equal to $\frac{1}{7}$ is .142857,
which multiplied by 3

produces the decimal equal to $\frac{3}{7}$. .428571,

Secondly. If there be cyphers annexed to the significant figures of the denominator, there will be an equal number of additional cyphers prefixed to the decimal. The reason of this will be evident, if we reduce these vulgar fractions to decimals, or if we consider that each cypher annexed to the denominator diminishes the value of the vulgar fraction ten times, and each cypher prefixed has a like effect on the value of the decimal.

Thus, $\frac{1}{7} = .142857$, $\frac{7}{25} = .28$ $\frac{1}{22} = .0,45$,
$\frac{1}{70} = .0,142857$, $\frac{7}{2500} = .0028$ $\frac{1}{2200} = .000,45$,

we may therefore confine our attention to vulgar fractions, whose numerator is 1, and which have no cyphers annexed to the significant figures of the denominator.

Thirdly. Vulgar fractions, whose denominators are 2 or 5, or any of their powers, produce terminate decimals; for, if any power of 2 be multiplied by the same power of 5, the product is an equal power of 10, as appears from the following table:

2	$\times$ 5		=	10
2^2 or	4 $\times$ 5^2	or 25	=	100 or 10^2
2^3 or	8 $\times$ 5^3	or 125	=	1000 or 10^3
2^4 or	16 $\times$ 5^4	or 625	=	10000 or 10^4
2^5 or	32 $\times$ 5^5	or 3125	=	100000 or 10^5

And the reason is easily pointed out; for $2^3 \times 5^3 = 2 \times 2 \times 2 \times 5 \times 5 \times 5$; or, because the factors may be taken in any order, $= 2 \times 5 \times 2 \times 5 \times 2 \times 5$; and this, if we multiply the factors by pairs, becomes $10 \times 10 \times 10$, or 10^3. The like may be shown of any other power. And we may infer, that if any power of 10 be divided by a like power of 2 or 5, the quotient will be an equal power of 5 or 2 respectively, and will come out exact, without a remainder; and, since the vulgar fractions above-mentioned are reduced to decimals by some such division, it follows that the equivalent decimals are terminate.

The number of places in the decimal is pointed out by the exponent of the power; for the dividend must be a like power of 10, or must have an equal number of cyphers annexed to 1, and each cypher of the dividend gives a place of the quotient.

Ex. $\frac{1}{32} = .03125$, a decimal of 5 places, and $32 = 2^5$.

```
32)1.00000(.03125
   96...
   ---
    40
    32
    ---
     80
     64
     ---
     160
     160
```

Again, no denominators except 2, 5, or their powers, produce terminate decimals. It is obvious from p. 298. col. 2. par. 4. that, if any denominator which produces a terminate decimal be multiplied thereby, the product will consist of 1, with cyphers annexed; and consequently the lowest places of the factors, multiplied into each other, must amount to 10, 20, or the like, in order to supply a cypher for the lowest place of the product; but none of the digits give a product of this kind, except 5 multiplied by the even numbers: therefore one of the factors must terminate in 5, and the other in an even number. The former is measured by 5, and the latter by 2, as was observed p. 297. col. 2. par. 7. Let them be divided accordingly, and let the quotients be multiplied. This last product will be exactly one tenth-part of the former; and therefore will consist of 1, with cyphers annexed, and the factors which produce it are measured by 5 and 2, as was shown before. This operation may be repeated; and one of the factors may be divided by 5, and the other by 2, till they be exhausted; consequently they are powers of 5 and 2.

Fourthly. Vulgar fractions, whose denominators are 3 or 9, produce pure repeating decimals.

Thus, $\frac{1}{9} = .11\dot{1}$ $\frac{5}{9} = .55\dot{5}$
$\frac{2}{9} = .22\dot{2}$ $\frac{2}{3}$ or $\frac{6}{9} = .06\dot{6}$
$\frac{1}{3}$ or $\frac{3}{9} = .33\dot{3}$ $\frac{7}{9} = .77\dot{7}$
$\frac{4}{9} = .444$ $\frac{8}{9} = .888$

The repeating figure is always the same as the numerator. Hence we infer, that repeating figures signify ninth-parts; a repeating 3 signifies $\frac{1}{3}$; a repeating 6 signifies $\frac{2}{3}$; and a repeating 9 signifies $\frac{5}{9}$, or 1.

The value of repeating decimals may also be illustrated by collecting the values of the different places: for example, let the value of $11\dot{1}$ be required; the first decimal place signifies $\frac{1}{10}$, the next $\frac{1}{100}$, the next $\frac{1}{1000}$. The sum of the two first places is $\frac{11}{100}$, of the three places $\frac{111}{1000}$; and so on. If we subtract these values successively from $\frac{1}{9}$, the first remainder is $\frac{1}{90}$, the second $\frac{1}{900}$, the third $\frac{1}{9000}$. Thus, when the value of the successive figures is reckoned, the amount of them approaches nearer and nearer to $\frac{1}{9}$, and the difference becomes 10 times less for each figure assumed; and, since the decimal may be extended to any length, the difference will at last become so small, that it need not be regarded. This may give a notion of a decreasing series, whose sum may be exactly ascertained, though the number of terms be unlimited.

Fifthly. Vulgar fractions, whose denominators are a product of 3 or 9 multiplied by 2, 5, or any of their powers, produce mixed repeaters. The reason of this will be evident, if, in forming the decimal, we divide the numerator successively by the component parts of the denominator, as directed p. 297. col 1. par. *ult.*

&c.

Intermi-nate Decimals.

&c. The first divisor is 2, 5, or some of their powers, and consequently gives a finite quotient by p. 316. col. 1. part 3, &c. The second divisor is 3 or 9; and therefore, when the figures of the dividend are exhausted, and figures annexed to the remainder, the quotient will repeat, by p. 316. col. 2. part 2.

Ex. $\frac{1}{144}$ 144=16×9.

```
                                9
144)1.000( 00694̇    or 16)1.00(.0625
    864                  96.00694
    ----                 -----
    1360                  40
    1296                  32
    ----                  --
  * 640                   80
    576                   80
    ---                   --
    640                   0
```

In order to illustrate this subject further, we shall explain the operation of casting out the threes, which resembles that for casting out the nines, formerly laid down, p. 300. col. 2. par. 4.—p. 301. col. 2 par. 3. and depends on the same principles, being a method of finding the remainder of a number divided by 3. If the same number be divided by 3 and by 9, the remainders will either agree, or the second remainder will exceed the first by 3 or by 6. The reason of this will be obvious, if we suppose a collection of articles assorted into parcels of 3, and afterwards into parcels of 9, by joining three of the former together. If the lesser parcels be all taken up in composing the greater ones, the remainder will be the same at the end of the second assortment as before; but if one of these lesser parcels be left over, the remainder will be more, and if two of them be left over, the remainder will be 6 more. Therefore, when the nines are cast out from any number, and the result divided by 3, the remainder is the same as when the number is divided by 3: Thus, the results on casting out the 3's may be derived from those obtained by casting out the 9's; and the same correspondence which was pointed out with respect to the latter, for proving the operations of arithmetic, applies also to the former.

To cast out the 3's from any number, add the figures, neglecting 3, 6, and 9; and when the sum amounts to 3, 6, or 9, reject them, and carry on the computation with the excess only. For example, take 286754: in casting out the 3's we compute thus, 2 and 8 is 10, which is three times 3, and 1 over; 1 and (passing by 6) 7 is 8, which is twice 3, and 2 over; 2 and 5 is 7, which is twice 3, and 1 over; *lastly*, 1 and 4 is 5, which contains 3 once, and 2 over, so the result is 2.

If the 3's be cast out from 2^2 or 4, the result is 1; from 2^3 or 8, the result is 2; from 2^4 or 16, the result is 1; and universally the odd powers of 2 give a result of 2, and the even powers give a result of 1. As every higher power is produced by multiplying the next lower by 2, the result of the product may be found by multiplying the result of the lower power by 2, and casting out the 3's, if necessary. Therefore, if the result of any power be 1, that of the next higher is 2, and that of the next higher (4 with the 3's cast out or) 1. Thus the results of the powers of 2 are 1 and 2 by turns; also, because the result of 5, when the 3's are cast out, is 2, its powers will have the same results as the corresponding powers of 2.

If the denominator be a product of an even power of 2 or 5, multiplied by 3, the repeating figure of the corresponding decimal is $\dot{3}$; but, if it be the product of an odd power, the repeating figure is 6. For, in forming the decimal, we may divide by the component parts of the denominator, and the first divisor is a power of 2 or 5; therefore the first quotient is a like power of 4 or 2, (p. 316. col. 1. par. 3. &c.) and this power is again divided by 3. If it be an even power, the remainder or result is 1, as was demonstrated above: and if cyphers be annexed to the remainder, and the division continued, it quotes a repeating 3; but if it be an odd power, the remainder is 2, and the quotient continued by annexing cyphers is a repeating 6.

If the denominator be 9, multiplied by 2, or any of its powers, the repeating figure may be found by casting out the 9's from the corresponding power of 5; and if it be multiplied by 5 or any of its powers, by casting out the 9's from the corresponding power of 2. For if the decimal be formed by two divisions, the first quotes the corresponding power; and the second, because the divisor is 9, repeats the resulting figure after the dividend is exhausted.

If any mixed repeater be multiplied by 9, the product is a terminate decimal, and may be reduced (p. 316. col. 1. part 3. &c.) to a vulgar fraction, whose denominator is 2, 5, or some of their powers; therefore all mixed repeaters are derived from vulgar fractions, whose denominators are products of 2, 5, or their powers multiplied by 3 or 9.

Sixthly. All denominators, except 2, 5, 3, 9, the powers of 2 and 5, and the products of these powers, multiplied by 3 or 9, produce circulating decimals. We have already shown, that all terminate decimals are derived from 2, 5, or their powers; all pure repeaters, from 3 or 9; and all mixed repeaters, from the products of the former multiplied by the latter. The number of places in the circle is never greater than the denominator diminished by unity. Thus $\frac{1}{7}$ produces .142857, a decimal of 6 places; and $\frac{1}{17}$ produces .0588235294117647, a decimal of 16 places. The reason of this limit may be inferred from the division; for whenever a remainder which has recurred before returns again, the decimal must circulate, and the greatest number of possible remainder is one less than the divisor: But frequently the circle is much shorter. Thus $\frac{1}{11}$ = .09, a circle of 2 places.

When a vulgar fraction, whose numerator is 1, produces a pure circulate, the product of the circle multiplied by the denominator will consist of as many 9's as there are places in the circle. Thus $\frac{1}{7}$ = .142857, which multiplied by 7 produces 999999. The like holds in every decimal of the same kind; for they are formed by dividing 10, or 100, or 1000, or some like number, by the denominator, and the remainder is 1, when the decimal begins to circulate; for the division must be then exactly in the same state as at the beginning: Therefore if the dividend had been less by 1, or had consisted entirely of 9's, the division would have come out without a remainder; and since the quotient, multiplied by the divisor, produces the dividend, as was shown p. 298. col. 2. part 3. it follows, that the circulating figures, multiplied by the denominator, produce an equal number of 9's.

Every vulgar fraction, which produces a pure circulate

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late, is equal to one whose numerator is the circulating figures, and its denominator a like number of 9's. If the numerator be one, the vulgar fraction is reduced to that form by multiplying both terms into the circle of the decimal; and if the numerator be more than 1, the equivalent decimal is found by multiplying that which correfponds to the numerator 1 into any other numerator.

Thus $\frac{1}{7}=.142857,=\frac{142857}{999999}$ and $\frac{1}{37}=.027.=\frac{27}{999}$.
$\frac{2}{7}=.285714,=\frac{285714}{999999}$ $\frac{2}{37}=.054.=\frac{54}{999}$
$\frac{3}{7}=.428571,=\frac{428571}{999999}$ $\frac{8}{37}=.216.=\frac{216}{999}$

Hence we may infer, that pure circulates are equal in value to vulgar fractions whose numerators confift of the circulating figures, and denominators of as many 9's as there are places in the circle. To place this in another point of view, we fhall reduce a vulgar fraction, whofe numerator confifts entirely of 9's, to a decimal.

```
375    999)375000(.375,
999        2997..
           ------
            7530
            6993
           ------
             5370
             4995
           ------
           * 375
```

The remainder is now the fame as the dividend, and therefore the quotient muft circulate; and, in general, fince any number with 3 cyphers annexed, may be divided by 1000, without a remainder, and quotes the fignificant figures; therefore, when divided by 999, it muft quote the fame figures, and leave an equal remainder. This alfo applies to every divifor which confifts entirely of 9's. Circles of two places, therefore, fignify ninety-ninth-parts; circles of 3 places fignify nine hundred and ninety-ninth-parts; and fo on.

The value of circulating decimals may alfo be illuftrated by adding the values of the places. Thus, if two figures circulate, the firft circle fignifieth hundredth parts, and every following circle fignifies one hundred-times lefs than the preceding; and their values added, as in p. 316. col. 2. part 3. will approach nearer to ninety-ninth-parts than any affigned difference, but will never exactly complete it.

All denominators which are powers of 3, except 9, produce pure circulates; and the number of places in the circle is equal to the quotient of the denominator divided by 9.

Thus, $\frac{1}{27}=.037$, a circle of 3 places, and 27 divided by 9=3.

$\frac{1}{81}=.012345679$, a circle of 9 places, and 81 divided by 9=9.

Thefe decimals may be formed, by dividing the numerator by the component parts of the denominator. In the firft example, the component parts of the numerator are 9 and 3. The divifion by 9 quotes a pure circulate, and the circulating figure is not 3, 6, or 9, if the vulgar fraction be in its loweft terms. And any other repeating figure divided by 3, quotes a pure circulate of 3 places; for the firft dividual muft leave a remainder of 1 or 2. If the firft remainder be 1, the fecond remainder is 2, (becaufe, if 1 be prefixed to the repeating figure, and the 3's be caft out, the refult is 2); and, for a like reafon, the third dividual clears off without a remainder. If the firft remainder be 2, the fecond is (twice 2 or 4, with the 3's caft out, or) 1, and the third 0; fo the circle is always complete at 3 places, and the divifion begins anew. The fum of fuch a circle cannot be a multiple of 3; for fince the repeating figure is not 3, nor any of its multiples, the fum of three places is not a multiple of 9, and therefore cannot be divided by 9, nor twice by 3, without a remainder.

Again, if the decimal equal to $\frac{1}{27}$ be divided by 3, we fhall obtain the decimal equal to $\frac{1}{81}$. The dividend, as we have fhown already, is a pure circulate of 3 places, whofe fum is not a multple of 3. Therefore, when divided by 3, the firft circle leaves a remainder of 1 or 2, which being prefixed to the fecond, and the divifion continued, the remainder, at the end of the fecond circle, is 2 or 1, and, at the end of the third circle, there is no remainder; all which may be illuftrated by cafting out the 3's. The divifion being completed at 9 places, finifhes the circle; and it may be fhown, as before, that the fum of thefe places is not a multiple of 3. The learner will apprehend all this if he reduce thefe, or the like vulgar fractions, to decimals, by fucceffive divifions.

$27 = 9 \times 3$, and $9)1.0(.111\dot{1}$, and $3).111\dot{1}(.037$,
$81 = 27 \times 3$, and $3)037,037,037(.012345679$.

For the fame reafon, if any circulating decimal, not a multiple of 3, be divided by 3, the quotient will circulate thrice as many places as the dividend; and if any circulate obtained by fuch divifion be multiplied by 3, the circle of the product will be reftricted to one-third of the places in the multiplicand.

All vulgar fractions, whofe denominators are multiples of 2, 5, or their powers, except thofe already confidered, produce mixed circulates; for they may be reduced by dividing by the component parts of the denominator. The firft divifor is 2, 5, or fome of their powers, and therefore gives a finite quotient. The fecond divifor is none of the numbers enumerated p. 317. col. 2. part 2. and therefore gives a circulating quotient when the fignificant figures of the dividend are exhaufted, and cyphers annexed to the remainder.

```
   Ex. 1/216                  216=27×8.
216)1.000(.004,629,        or 8)1.000
     864                    27) .125(.004,629,
    -----                        108
   *1360                        ----
    1296                        *170
    -----                        162
      640                       ----
      432                          80
    -----                          54
     2080                        ----
     1944                         260
    -----                         243
  *  1360                        ----
                                   17
```

All mixed circulates are derived from vulgar fractions

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tions of this kind, whose denominators are multiples of 2, 5, or their powers; and therefore all other denominators, except 3 and 9, produce pure circulates. The reader will easily perceive, that when a decimal is formed from a vulgar fraction whose numerator is 1, when the remainder 1 occurs in the division, the decimal is a pure circulate; but if any other remainder occurs twice, the decimal is a mixed circulate. We are to show that this last will never happen, unless the divisor be a multiple of 2, 5, or their powers. If two numbers be prime to each other, their product will be prime to both; and if two numbers be proposed, whereof the first does not measure the second, it will not measure any product of the second, if the multiplier be prime to the first. Thus, because 7 does not measure 12, it will not measure any product of 12 by a multiplier prime to 7. For instance, it will not measure 12×3, or 36. Otherwise, the quotient of 12 divided by 7, or $1\frac{5}{7}$ multiplied by 3, would be a whole number, and 5×3 would be measured by 7, which it cannot be, since 5 and 3 are both prime to 7.

Now, if we inspect the foregoing operation, we shall perceive that the product of 136, the remainder, where the decimal begins to circulate, multiplied by 999, is measured by the denominator 216. But 999 is not measured by the denominator, otherwise the decimal would have been a pure circulate; therefore 126 and 136 are not prime to each other, but have a common measure, and that measure must apply to 864, a multiple of 126, and to 1000, the sum of 136 and 864; see p. 309, col. 2. par. *ult.* &c. But it was proven, p. 316. col. 1. par. 1. that no numbers, except the powers of 5 and 2, measure a number consisting of 1 with cyphers annexed; consequently the denominator must be measured by a power of 2 or 5. The reader will perceive, that the exponent of the power must be the same as the number of cyphers annexed to 1, or as the number of figures in the finite part of the decimal.

We shall now recapitulate the substance of what has been said with respect to the formation of decimals. 2, 5, and their powers, produce finite decimals, by p. 316. col. 1 par. 3. &c. and the number of places is measured by the exponent of the power. 3 and 9 produce pure repeaters (p. 316. col. 2. par. 2.) The products of 2, 5, and their powers, by 3, or 9, produce mixed repeaters by p. 316. col. 2. par. *ult.* their products by other multipliers, produce mixed circulates by p. 316. col. 2. par. *ult.* and all numbers of which 2 and 5 are not aliquot parts, except 3 and 9, produce pure circulates. To find the form of a decimal corresponding to any denominator, divide by 2, 5, and 10, as often as can be done without a remainder: the number of divisions shows how many finite places there are in the decimal, by p. 318. col. 2. par. 3. If the dividend be not exhausted by these divisions, divide a competent number of 9's by the last quotient, till the division be completed without a remainder: the number of 9's required show how many places there are in the circle; and the reason may be inferred from p. 317. col. 2. par. 5.

We shall conclude this subject by marking down the decimals produced by vulgar fractions, whose numerator is 1, and denominators 30; and under that the reader may observe their connection with the denominators.

$\frac{1}{2}$=.5	$\frac{1}{16}$=.0625
$\frac{1}{3}$=.333	$\frac{1}{17}$=.0588235294117647,
$\frac{1}{4}$=.25	$\frac{1}{18}$=.0555
$\frac{1}{5}$=.2	$\frac{1}{19}$=.052631578947368421,
$\frac{1}{6}$=.1666	$\frac{1}{20}$=.05
$\frac{1}{7}$=.142857,	$\frac{1}{21}$=.047619
$\frac{1}{8}$=.125	$\frac{1}{22}$=.0,45,45
$\frac{1}{9}$=.111	$\frac{1}{23}$=.0434782608695652173913,
$\frac{1}{10}$=.1	$\frac{1}{24}$=.041666
$\frac{1}{11}$=.09,09,	$\frac{1}{25}$=.04
$\frac{1}{12}$=.08333	$\frac{1}{26}$=.0384615,
$\frac{1}{13}$=.079623,	$\frac{1}{27}$=.037,
$\frac{1}{14}$=.0714285,	$\frac{1}{28}$=.03,571428,
$\frac{1}{15}$=.0666	$\frac{1}{29}$=.0344827586206896551724137931,
	$\frac{1}{30}$=0333

Rules *for reducing interminate decimals to vulgar fractions.*

I. "If the decimal be a pure repeater, place the repeating figure for the numerator, and 9 for the denominator."

II. "If the decimal be a pure circulate, place the circulating figures of the numerator, and as many 9's as there are places in the circle for the denominator."

III. "If there be cyphers prefixed to the repeating or circulating figures, annex a like number to the 9's in the denominator."

IV. "If the decimal be mixed, subtract the finite part from the whole decimal. The remainder is the numerator; and the denominator consists of as many 9's as there are places in the circle, together with as many cyphers as there are finite places before the circle."

Thus, 235,62,=$\frac{23372}{99000}$

From the whole decimal	23562
we subtract the finite part	234
and the remainder	23327 is the numerator.

The reason may be illustrated by dividing the decimal into two parts, whereof one is finite, and the other a pure repeater or circulate, with cyphers prefixed. The sum of the vulgar fractions corresponding to these will be the value of the decimal sought.

.235,62, may be divided into .235 =$\frac{235}{1000}$ by rule I.
and .000,62=$\frac{62}{99000}$ by rules II. III.

In order to add these vulgar fractions, we reduce them to a common denominator; and, for that purpose, we multiply both terms of the former by 99, which gives $\frac{23265}{99000}$; then we add the numerators.

235	or by method explained p. 295. col. 1. par. 3.		
99		Sum of numerators.	
2115	23500	23265	or 23562
2115	235	62	235
23265	23265	23327	23327

The value of circulating decimals is not altered, though one or more places be separated from the circle, and considered as a finite part, providing the circle be completed. For example, .27 may be written .2,72, which is reduced by the last of the foregoing rules to $\frac{270}{990}$, or $\frac{27}{99}$, which is also the value of .27. And if two or more circles be joined, the value of the decimal is still the same. Thus, 2727,=$\frac{2727}{9999}$, which is reduced by dividing the terms 101 to $\frac{27}{99}$.

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All circulating decimals may be reduced to a similar form, having a like number both of finite and circulating places. For this purpose, we extend the finite part of each as far as the longest, and then extend all the circles to so many places as may be a multiple of the number of places in each.

Ex. .34,725, extended .34,725725725725725,
1,4562, 14,562456245624,

Here the finite part of both is extended to two places, and the circle to 12 places, which is the least multiple for circles of 3 and 4 places.

30 Sect. ii. ADDITION *and* SUBTRACTION *of* INTERMINATE DECIMALS.

To add repeating decimals, "Extend the repeating "figures one place beyond the longest finite ones, and "when you add the right-hand column, carry to the "next by 9."

Ex. .37524 or	37524	.25	.296	$\frac{7}{36}$
.8	88888	.328	.42	$\frac{11}{45}$
.643	643	.4697	.7548	$\frac{11}{72}$
.73	73333	.36	.31	$\frac{2}{75}$
	264046			

To subtract repeating decimals, "Extend them as "directed for addition, and borrow at the right-hand "place if necessary, by 9.

.93566	.646	.7358	.7382	.469
.84738	.53427	.62563	.68	.35
.08727	.11172			

The reason of these rules will be obvious, if we recollect that repeating figures signify ninth-parts. If the right-hand figure of the sum or remainder be o, the decimal obtained is finite; otherwise it is a repeater.

To add circulating decimals, "Extend them till they "become similar (p. 319. col. 1. par. ult. &c.); and "when you add the right-hand column, include the figure which would have been carried if the circle had "been extended further.

Ex. 1st.]	*Extended.*	*Ex.* 2d.]	*Extended.*
.574,	.574,574,	.874,	.874,874874,
.2,698,	.266,869,	.1463	.146,333333,
.428	.428	.1,58,	.158,585858,
.37,983,	.379,839,	.32,	.323,232323,
	1.652,284,		1.503,026390,

Note 1. Repeaters mixed with circulates are extended and added as circulates.

Note 2. Sometimes it is necessary to inspect two or more columns for ascertaining the carriage; because the carriage from a lower column will sometimes raise the sum of the higher, so as to alter the carriage from it to a new circle. This occurs in Ex. 2.

Note 3. The sum of the circles must be considered as a similar circle. If it consist entirely of cyphers, the amount is terminate. If all the figures be the same, the amount is a repeater. If they can be divided into parts exactly alike, the amount is a circle of fewer places; but, for the most part, the circle of the sum is similar to the extended circles.

.3,868,	.0842,	$\frac{2}{7}$	.368	.003094,	$\frac{5}{81}$
.4,375,	.08,42	$\frac{3}{5}$	.57,	.765,	$\frac{7}{48}$
.853492,	.0,842	$\frac{8}{11}$	.895	.76,	$\frac{2}{11}$
.62,	.0842	$\frac{16}{17}$	.724	.765,	$\frac{3}{71}$

To subtract circulating decimals, "Extend them till "they become similar; and when you subtract the "right-hand figure, consider whether 8 would have "been borrowed if the circles had been extended fur- "ther, and make allowance accordingly.

.5,72,	.974, or	.974974,	.8,135, or	.8,135135,
.4,86,	.86	.868686,	.452907 or	.4,529074,
.0,85,		.106288,		.3,606060,
			or,	3,60

Sect. iii. MULTIPLICATION *of* INTERMINATE DECIMALS.

CASE I. "When the multiplier is finite, and the "multiplicand repeats, carry by 9 when you multiply "the repeating figure: The right-hand figure of each "line of the product is a repeater; and they must be "extended and added accordingly."

```
Ex. .13494
      .367
    ------
     94461
    809666
   4048333
   -------
 .04952461
```

If the sum of the right-hand column be an even number of 9's, the product is finite; otherwise, it is a repeater.

CASE II. "When the multiplier is finite, and the "multiplicand circulates, add to each product of the "right-hand figure the carriage which would have "been brought to it if the circle had been extended. "Each line of the product is a circle similar to the "multiplicand, and therefore they must be extended "and added accordingly."

The product is commonly a circulate similar to the multiplicand; sometimes it circulates fewer places, repeats, or becomes finite; it never circulates more places.

```
Ex.  .37,46,×.235      1.  .674,  ×.78
        235            2.  .37,   ×.86
     -------           3.  .625,  ×.42
     187,32,           4.  .4793, ×4.8
    1123,93,           5.  .3,75, ×1.24
    7492,92,           6.  .2,963, ×.36
   ---------
  .08804,19,
```

CASE III. "When the multiplier repeats or circulates, find the product as in finite multipliers, and "place under it the products which would have arisen "from the repeating or circulating figures, if extend- "ed."

```
Ex. 1st.]  .958×.8          2d.]  .784×.86,
              8                     36
           -----                  -----
           7664                   4704
            766|4                 2352
             76|64               ------
              7|664              28224|
               |7664               282|24
           ---------                 2|8224
            .8515                ----------
                                  .284,09,
```

2 3d.]

Intermi-nate Deci-mals.

```
3d.]      .714285,×54,
                    54
          ---------
           2859142
          35714285
          ------------------------------
          31,571428|571428|571428,
              385714|285714|285714,
                3857|142857|142857,
                    |------|-------
                  38|571428|571428,
                    |385714|285714,
                    |  3857|142875,
                    |      |-------
                    |    38|571428
                    |      |385714
                    |      |  3857
                    |      |    38
          ------------------------------
          38.961038,961038,961038,
```

It is evident, that, if a repeating multiplier be extended to any length, the product arising from each figure will be the same as the first, and each will stand one place to the right hand of the former. In like manner, if a circulating multiplier be extended, the product arising from each circle will be alike, and will stand as many places to the right hand of the former as there are figures in the circle. In the foregoing examples, there are as many of these products repeated as is necessary for finding the total product. If we place down more, or extend them further, it will only give a continuation of the repeaters or circulates.

This is obvious in Ex. 1st and 2d. As the learner may not apprehend it so readily in Ex. 3d, when the multiplicand is a circulate, and consequently each line of the product is also a circulate, we have divided it into columns, whose sums exhibit the successive circles. The sum of the first column is 38,961037, and there is a carriage of 1 from the right-hand column, which completes 38,961038. This one is supplied from the three first lines of the second column, the sum of which is 999999, and being increased by 1, in consequence of the carriage from the third column, amounts to 1,000000, and therefore carries 1 to the first column, and does not affect the sum of the remaining lines, which are the same as those of the first column. The third column contains two sets of these lines, which amount to 999999, besides the line which compose the circle. Each of these sets would be completed into 1,000000 by the carriage from the 4th column, if extended, and each would carry 1 to the second column. One of these would complete the sum of the three first lines, and the other would complete the sum of the circle. In like manner, if the circles be extended ever so far, the increasing carriages will exactly answer for the increasing deficiencies, and the sum will be always a continuation of the circle: but the product could not circulate, unless the sum of the lines marked off in the second column had consisted entirely of 9's; or had been some multiple of a number of 9's; and the circles must be extended till this take place, in order to find the complete product.

The multiplication of intermediate decimals may be often facilitated, by reducing the multiplier to a vulgar fraction, and proceeding as directed p. 311. col. 1. par. 6. Thus,

```
4th.]  .3824×7̇.=7/9          5th.]  .384×.25̇=23/90.
               7                         23      2
        --------                         --     --
       9)2.6768                         1152    23
          .9742̇                          768
                                       -----
                                     90)8.832
                                        .09813̇
```

Therefore, in order to multiply by 3̇, we take one-third part of the multiplier; and, to multiply by 6̇, we take two-thirds of the same. Thus,

```
6th.]  .784=.3̇×1/3.          7th.]  .8761×.6̇=2/3
                                               2
                                         -------
       3).784                           3)1.7522
          .2613̇                            .58406̇
```

As the denominator of the vulgar fractions always consists of 9's, or of 9's with cyphers annexed, we may use the contraction explained p. 298. col. 1. par. *ult.* &c.; and this will lead us exactly to the same operation which was explained p. 320. col. 2. par. *ult.* &c. on the principles of decimal arithmetic.

```
8th.]  .735×.3,26,=323/990    9th.]  .278×365,=365/999
           323      3                     365
        ------   ----                    -----
          2205    323                     1390
         1470                            1668
        2205                             834
        ------                          -------
  99|0)237405                      999)101470,
          2374,05                        101,
            23,74                       ------
              ,23                      .101,571,
      ------------
      .239803,
```

When the multiplier is a mixed repeater or circulate, we may proceed as in Ex. 5th and 8th; or we may divide the multiplier into two parts, of which the first is finite, and the second a pure repeater or circulate, with cyphers prefixed, and multiply separately by these, and add the products.

```
Thus, .384×.25̇  or by .2 =.0768   or thus,   .384
           and by .05 =.02133̇                  .25̇
                      -------                 -----
                       .09813                9)1920
                                              -----
                                               2133̇
                                               768
                                              -----
                                              09813̇
```

In the following examples, the multiplicand is a repeater; and therefore the multiplication by the numerator of the vulgar fraction is performed as directed p. 320. col. 2. par. 2.

Interminate Decimals.

```
10th.] .683̇×.5̇ 5/9
         5
       ———
   9)3.416̇(.37,962,
     27
     ——
      71
      63
      ——
    * 86
      81
      ——
       56
       54
       ——
        26
        18
        ——
      * 86
```

```
11th.] .63×.2,39,= 237/990
       .237    2
       ————————
        443̇  237
       1899̇
      12666̇
      ——————
  99)15010(.15,16,
     99
     ———
     511
     495
     ———
   * 160
      99
      ———
      610
      594
    *  16
```

In the following examples the multiplicand is a circulate, and therefore the multiplication by the numerator is performed as directed p. 320. col. 2. par. 4.

```
12th.] .3,81,×53̇=48/90
          48    5
          ————————
          3054 48
         15272
         ——————
   9|0)183,27,(.203,63,
        18
        ———
      * 032
         27
         ——
          57
          54
          ——
        * 32
```

```
13th.] .12,×03=3/99
           3
       ————————
  99)36,36(.036730945821854912764,
     666
       723
        306
         936
          453
           576
            813
             216
              183
               846
                543
                 486
                  903
                   126
                    273
                     756
                      633
                       396
                     * 036
```

In Ex. 13th, we have omitted the products of the divisor, and only marked down the remainders. These are found, by adding the left-hand figure of the dividual to the remaining figures of the same. Thus 363 is the first dividual, and 3 the left-hand figure, added to 63, the remaining figures, gives 66, for the first remainder; and the second dividual, 666, is completed by annexing the circulating figure 6. The reason of which may be explained as follows. The highest place of each dividual shows, in this example, how many hundreds it contains; and as it must contain an equal number of ninety-nines, and also an equal number of units, it follows, that these units, added to the lower places, must show how far the dividual exceeds that number of ninety-nine. The figure of the quotient is generally the same as the first place of the dividual, sometimes one more. This happens in the last step of the foregoing example, and is discovered when the remainder found, as here directed, would amount to 99, or upwards; and the excess, above 99 only, must in that case be taken to complete the next dividual.

```
14th.].01,×.01,=1/99
        1
      ————
  99).01,(00010203040506070809101112131415161718192О
         (2122232425262728293031323334353637383940
         (4142434445464748495051525354555657585960
         (6162636465666768697071727374757677787980
         (81828384858687888990919293949596979899
```

The number of places in the circle of the product is sometimes very great, though there be few places in the factors: but it never exceeds the product of the denominator of the multiplier, multiplied by the number of places in the circle of the multiplicand. Therefore, if the multiplier be 3̇ or 6, the product may circulate three times as many places as the multiplicand; if the multiplier be any other repeater, nine times as many; if the multiplier be a circulate of two places, ninety-nine times as many; thus, in the last example, .01, a circulate of two places, multiplied by .01, a circulate of two places, produces a circulate of twice 99, or 198 places. And the reason of this limit may be inferred from the nature of the operation; for the greatest possible number of remainders, including 0, is equal to the divisor 99; and each remainder may afford two dividuals, if both the circulating figures, 3 and 6, occur to be annexed to it. If the multiplier circulate three places, the circle of the product, for a like reason, may extend nine hundred and ninety-nine times as far as that of the multiplicand. But the number of places is often much less.

The multiplication of the interminate decimals may be proven, by altering the order of the factors, (p. 295. col. 2. par. 2.) or by reducing them both to vulgar fractions in their lowest terms, multiplying these as directed p. 310. col. 2. par. 3. and reducing the product to a decimal.

Sect. iv. Division *of* Interminate Decimals. 32

Case I. "When the dividend only is interminate, "proceed as in common arithmetic; but, when the "figures of the dividend are exhausted, annex the re- "peating figure, or the circulating figures in their or- "der, instead of cyphers, to the remainder."

Ex.

Interminate Decimals.

Ex. 1ſt.] Divide .5376 by 7,

```
7.).5376(.76,095238,
    49
    --
     42
     42
     --
   * 066
      63
      --
       36
       35
       --
        16
        14
        --
         26
         21
         --
          56
          56
          --
        * 066
```

2d.] Divide .843 by 5

```
.5)843(.1686
   5
   --
   34
   30
   --
   43
   40
   --
 * 33
   30
   --
   33
```

3d.] Divide .65328 by [8.

8).65328(.081661.

In theſe accounts the quotient is never finite. It may repeat, if the dividend repeats; or, if the dividend circulate, it may circulate an equal number of places, often more, and never fewer. The greateſt poſſible extent of the circle is found by multiplying the diviſor into the number of places in the circle of the dividend. Thus, a circulate of 3 places, divided by 3, quotes a circulate of 3 times 3, or 9 places.

Case II. "When the diviſor is interminate, the "multiplications and ſubtractions muſt be performed, "according to the directions given for repeating and "circulating decimals."

Ex. 1ſt.] Divide .37845 by 5

```
5).37845(.68121
   333333
   ------
    45116
    44444
    -----
      672
      555
      ---
      116
      111
      ---
        5
        5
        -
        0
```

2d.] Divide .245892 by 2,18,

```
.2,18,).245892(1. 127005
        .218181,81,
        -----------
         27710,18,
         21818,18,
         ---------
          5892,00,
          4363,63,
          --------
          1528,36,
          1527,27,
          --------
              1090,90,
             10,90,90,
             ---------
                 0
```

Extraction of Roots.

The foregoing method is the only one which properly depends on the principles of decimal arithmetic; but it is generally ſhorter to proceed by the following rule.

"Reduce the diviſor to a vulgar fraction, multiply "the dividend by the denominator, and divide the product by the numerator."

Ex. 1ſt.] Divide .37845 by 5=5/9

```
       9
    ------
5)3.40605(.68121
```

2d.] Divide .37845 by 6=2/3

```
       3
    ------
2)1.13536(.567683
```

Note 1. Diviſion by 3 triples the dividend, and diviſion by 6 increaſes the dividend one-half.

Note 2. When the diviſor circulates, the denominator of the vulgar fraction conſiſts of 9's, and the multiplication is ſooner performed by the contraction explained p. 295. col. 1. par. 1. It may be wrought in the ſame way, when the diviſor repeats, and the denominator, of conſequence, is 9.

Note 3. If a repeating dividend be divided by a repeating or circulating diviſor; or, if a circulating dividend be divided by a ſimilar circulating dividend; or, if the number of places in the circle of the diviſor be a multiple of the number in the dividend; then the product of the dividend multiplied by the denominator of the diviſor will be terminate, ſince like figures are ſubtracted from like in the contracted multiplication, and conſequently no remainder left. The form of the quotient depends on the diviſor, as explained at large, p. 316. col. 1. par. 1.—p. 318. col. 2. par. 3.

Note 4. In other caſes, the original and multiplied dividend, are ſimilar, and the form of the quotient is the ſame as in the caſe of a finite diviſor. See p. 322. col. 2. par. *ult.* &c.

Note 5. If the terms be ſimilar, or extended till they become ſo, the quotient is the ſame as if they were finite, and the operation may be conducted accordingly; for the quotient of vulgar fractions that have the ſame denominator is equal to the quotient of their numerators.

Chap. XI. Of the EXTRACTION of ROOTS. 33

The origin of powers by involution has already been explained under the article Algebra. There now remains therefore only to give the moſt expeditious methods of exracting the ſquare and cube roots; the reaſons of which will readily appear from what is ſaid under that article. As for all powers above the cube, unleſs ſuch as are multiples of either the ſquare and cube, the extraction of their roots admits of no deviation from the algebraic canon which muſt be always conſtructed on purpoſe for them.

If the root of any power not exceeding the ſeventh power, be a ſingle digit, it may be obtained by inſpection, from the following table of powers.

1st power or root.	2d power or square.	3d power or cube.	4th power or biquadrate.	5th power or surfolid.	6th power or cube squared.	7th power.
1	1	1	1	1	1	1
2	4	8	16	32	64	128
3	9	27	81	243	729	2187
4	16	64	256	1024	4096	16384
5	25	125	625	3125	15625	78125
6	36	216	1296	7776	46656	279936
7	49	343	2401	16807	117649	823543
8	64	512	4096	32768	262144	2097152
9	81	729	6561	59049	531441	4782969

34 Sect. i. EXTRACTION *of the* SQUARE ROOT.

RULE I. "Divide the given number into periods "of two figures, beginning at the right hand in integers, and pointing towards the left. But in decimals begin at the place of hundreds, and point toward the right. Every period will give one figure "in the root."

II. "Find by the table of powers, or by trial, "the nearest lesser root of the left hand period, place "the figure so found in the quot, subtract its square "from the said period, and to the remainder bring "down the next period for a dividual or resolvend."

III. "Double the quot for the first part of the "divisor; inquire how often this first part is contained in the whole resolvend, excluding the unit place; "and place the figure denoting the answer both in the "quot and on the right of the first part; and you have "the divisor complete."

IV. "Multiply the divisor thus completed by the "figure put in the quot, subtract the product from "the resolvend, and to the remainder bring down the "following period for a new resolvend, and then proceed as before."

Note 1. If the first part of the divisor, with unity supposed to be annexed to it, happen to be greater than the resolvend, in this case place 0 in the quot, and also on the right-hand of the partial divisor; to the resolvend bring down another period; and proceed to divide as before.

Note 2. If the product of the quotient-figure into the divisor happen to be greater than the resolvend, you must go back, and give a lesser figure to the quot.

Note 3. If, after every period of the given number is brought down, there happen at last to be a remainder, you may continue the operation, by annexing periods, or pairs of cyphers, till there be no remainder, or till the decimal part of the quot repeat or circulate, or till you think proper to limit it.

Ex. 1st. Required the square root of 133225.

```
Square number 133225(365 root          365
              9                        365
                                      ----
1 div. 66)  432 resolvend.            1825
            396 product.              2190
            ---                       1095
2 div. 725) 3625 resolvend.          ------
            3625 product.           133225 proof.
```

2d.] Required the square root of 72, to eight decimal places.

```
72.00000000(8.48528137 root.
64
-----
164)800
    656
-----
1688)14400
     13504
-----
16965)89600
      84825
-----
169702)477500
       339404
-----
169704)138096
  .... 135763
       ------
         2333
         1697
         ----
          636
          509
          ---
          127
          118
          ---
          (9)
```

After getting half of the decimal places, work by contracted division for the other half; and obtain them with the same accuracy as if the work had been at large.

3d.]. Required the square root of .2916.

```
.2916(.54 root.
 25
 ---
104)416
    416
```

If the square root of a vulgar fraction be required, find the root of the given numerator for a new numerator, and find the root of the given denominator for a new denominator. Thus, the square root of $\frac{4}{9}$ is $\frac{2}{3}$, and the root of $\frac{16}{25}$ is $\frac{4}{5}$; and thus the root of $\frac{25}{4}$ ($=6\frac{1}{4}$) is $\frac{5}{2}=2\frac{1}{2}$.

But if the root of either the numerator or denominator cannot be extracted without a remainder, reduce the vulgar fraction to a decimal, and then extract the root, as in Ex. 3d. above.

Sect. ii. EXTRACTION *of the* CUBE ROOT. 35

RULE I. "Divide the given number into periods "of three figures, beginning at the right-hand in integers, and pointing towards the left. But in decimals, begin at the place of thousands, and point towards the right. The number of periods shows the "number of figures in the root."

II. "Find by the table of powers, or by trial, the "nearest lesser root of the left-hand period; place the "figure so found in the quot; subtract its cube from "the said period; and to the remainder bring down "the next period for a dividual or resolvend."

The divisor consists of three parts, which may be found as follows.

III.

Extraction of Roots.

III. "The first part of the divisor is found thus: "Multiply the square of the quot by 3, and to the product annex two cyphers; then inquire how often this "first part of the divisor is contained in the resolvend, "and place the figure denoting the answer in the quot."

IV. "Multiply the former quot by 3, and the product by the figure now put in the quot; to this last "product annex a cypher; and you have the second "part of the divisor. Again, square the figure now "put in the quot for the third part of the divisor; "place these three parts under one another, as in addition; and their sum will be the divisor complete."

V. "Multiply the divisor, thus completed, by the "figure last put in the quot, subtract the product from "the resolvend, and to the remainder bring down the "following period for a new resolvend, and then proceed as before."

Note 1. If the first part of the divisor happen to be equal to or greater than the resolvend, in this case, place 0 in the quot, annex two cyphers to the said first part of the divisor, to the resolvend bring down another period, and proceed to divide as before.

Note 2. If the product of the quotient-figure into the divisor happen to be greater than the resolvend, you must go back, and give a lesser figure to the quot.

Note 3. If, after every period of the given number brought down, there happen at last to be a remainder, you may continue the operation by annexing periods of three cyphers till there be no remainder, or till you have as many decimal places in the root as you judge necessary.

Ex. 1st.] Required the cube root of 12812904.

```
Cube number 12812904(234 root.
             8
1st part  1200 }        )4812 resolvend.
2d part    180 }
3d part      9 }
1 divisor 1389×3=4167 product
1st part 158700 }   )645904 resolvend.
2d part    2760 }
3d part      16 }
2 divisor 161476×4=645904 product.
```

PROOF.

```
      234            Square 54756
      234                     234
      936                  219024
     702                  164268
    468                  109512
Square 54756          Cube 12812904
```

2d.] Required the cube root of $28\frac{3}{4}$

```
                 28.750000(3.06 root.
                 27
270000 }  )1750000 resolv.
  5400 }
    36 }
Div. 275436×6=1652616 prod.
                 97384 rem.
```

PROOF.

```
     3.06          Sq. 9.3636
     3.06                3.06
     1836              561816
    918               280908
Sq. 9.3636           28.652616
                        97384 rem.
                     28.750000 cube.
```

If the cube root of a vulgar fraction be required, find the cube root of the given numerator for a new numerator, and the cube root of the given denominator for a new denominator. Thus, the cube root of $\frac{8}{27}$ is $\frac{2}{3}$, and the cube root of $\frac{27}{64}$ is $\frac{3}{4}$: and thus the cube root of $\frac{125}{8}$ ($=15\frac{5}{8}$) is $\frac{5}{2}=2\frac{1}{2}$.

But if the root of either the numerator or denominator cannot be extracted without a remainder, reduce the vulgar fraction to a decimal, and then extract the root.

ARIUS, a divine of the fourth century, the head and founder of the ARIANS, a sect which denied the eternal divinity and substantiality of the Word. He was born in Libya, near Egypt. Eusebius bishop of Nicomedia, a great favourite of Constantia sister of the emperor Constantine and wife of Licinius, became a zealous promoter of Arianism. He took Arius under his protection, and introduced him to Constantia; so that the sect increased, and several bishops embraced it openly. There arose, however, such disputes in the cities, that the emperor, in order to remedy these disorders, was obliged to assemble the council of Nice, where, in the year 325, the doctrine of Arius was condemned. Arius was banished by the emperor, all his books were ordered to be burnt, and capital punishment was denounced against whoever dared to keep them. After five years banishment, he was recalled to Constantinople, where he presented the emperor with a confession of his faith, drawn up so artfully, that it fully satisfied him. Notwithstanding which, Athanasius, now advanced to the see of Alexandria, refused to admit him and his followers to communion. This so enraged them, that, by their interest at court, they procured that prelate to be deposed and banished. But the church of Alexandria still refusing to admit Arius into their communion, the emperor sent for him to Constantinople; where, upon delivering in a fresh confession of his faith in terms less offensive, the emperor commanded Alexander, the bishop of that church, to receive him the next day into his communion: but that very evening Arius died. The manner of his death was very extraordinary: as his friends were conducting him in triumph to the great church of Constantinople, Arius, pressed by a natural necessity, stepped aside to ease him-

 himſelf; but expired on the ſpot, his bowels guſhing out.

But the hereſy did not die with the hereſiarch; his party continued ſtill in great credit at court. Athanaſius, indeed, was ſoon recalled from baniſhment, and as ſoon removed again; the Arians being countenanced by the government, and making and depoſing biſhops as it beſt ſerved their purpoſes. In ſhort, this ſect continued with great luſtre above 300 years: it was the reigning religion of Spain for above two centuries; it was on the throne both in the eaſt and weſt; it prevailed in Italy, France, Pannonia, and Africa; and was not extirpated till about the end of the 8th century.

This hereſy was again ſet on foot in the weſt by Servetus, who, in 1531, wrote a little treatiſe againſt the myſtery of the Trinity. After his death, Arianiſm got footing in Geneva; from whence it removed into Poland; but at length, degenerated, in a great meaſure, into Socinianiſm. Eraſmus ſeems to have aimed at reviving Arianiſm, in his commentaries on the New Teſtament; and the learned Grotius ſeems to lean a little that way.

With regard to the ſtate of Arianiſm in England, it may be ſufficient to obſerve, that from the numerous publications of that caſt which are daily making their appearance, it ſeems to be rather a growing, than exploded, doctrine there.

Plate LVII. fig. 1 ARK, or *Noah's Ark*, a floating veſſel built by Noah for the preſervation of his family and the ſeveral ſpecies of animals during the deluge.

The ark has afforded ſeveral points of curious inquiry among the critics and naturaliſts, relating to its form, capacity, materials, &c.

The wood whereof the ark was built is called in the Hebrew *Gopher-wood*, and in the ſeptuagint *ſquare timbers*. Some tranſlate the original *cedar*, others *pine*, others *box*, &c. Pelletier prefers cedar on account of its incorruptibility, and the great plenty of it in Aſia: whence Herodotus and Theophaſtrus relate, that the kings of Egypt and Syria built whole fleets thereof, inſtead of deal.

The learned Mr Fuller, in his Miſcellanies, has obſerved, that the wood whereof the ark was built was nothing but that which the Greeks call κυπαρισσος, or or the *cypreſs-tree*; for, taking away the termination, *kypar* and *gopher* differ very little in ſound. This obſervation the great Bochart has confirmed, and ſhown very plainly that no country abounds ſo much with this wood as that part of Aſſyria which lies about Babylon.

In what place Noah built and finiſhed his ark is no leſs made a matter of diſputation. But the moſt probable opinion is, that it was built in Chaldea, in the territories of Babylon, where there was ſo great a quantity of cypreſs in the groves and gardens in Alexander's time, that that prince built a whole fleet out of it for want of timber. And this conjecture is confirmed by the Chaldean tradition, which makes Xithurus (another name for Noah) ſet ſail from that country.

The dimenſions of the ark, as given by Moſes, are 300 cubits in length, 50 in breadth, and 30 in height; which ſome have thought too ſcanty, conſidering the number of things it was to contain; and hence an argument has been drawn againſt the authority of the relation. To ſolve this difficulty many of the ancient fathers, and the modern critics, have been put to very miſerable ſhifts: But Buteo and Kircher have proved geometrically, that, taking the common cubit of a foot and a half, the ark was abundantly ſufficient for all the animals ſuppoſed to be lodged in it. Snellius computes the ark to have been above half an acre in area. Father Lamy ſhows, that it was 110 feet longer than the church of St Mary at Paris, and 64 feet broader: and if ſo, it muſt have been longer than St Paul's church in London, from weſt to eaſt, and broader than that church is high in the inſide, and 54 feet of our meaſure in height; and Dr Arbuthnot computes it to have been 81062 tons.

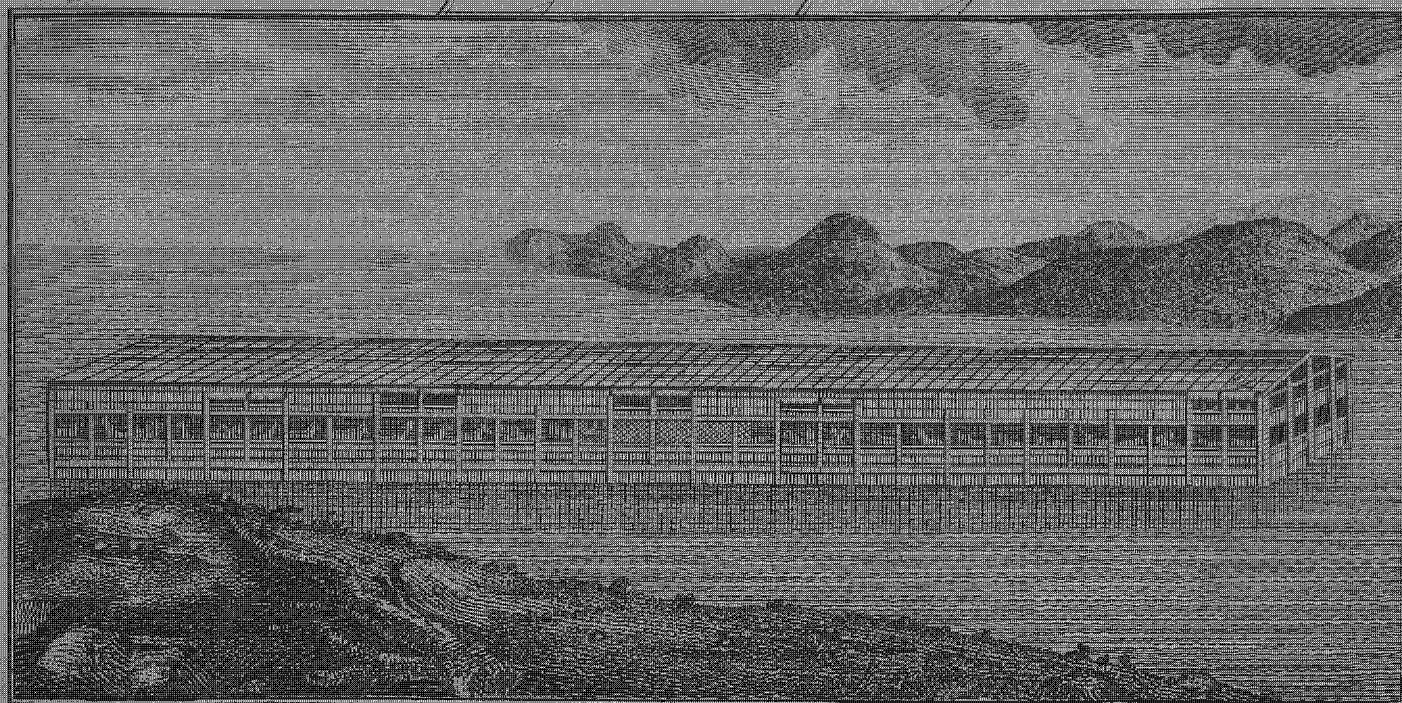
The things contained in it were, beſides eight perſons of Noah's family, one pair of every ſpecies of unclean animals, and ſeven pair of every ſpecies of clean animals, with proviſions for them during the whole year. The former appears, at firſt view, almoſt infinite; but if we come to a calculation, the number of ſpecies of animals will be found much leſs than is generally imagined; out of which, in this caſe, are excepted ſuch animals as can live in the water; and biſhop Wilkins ſhows that only 72 of the quadruped kind needed a place in the ark.

By the deſcription Moſes gives of the ark, it appears to have been divided into three ſtories, each ten cubits or 15 feet high; and it is agreed on, as moſt probable, that the loweſt ſtory was for the beaſts, the middle for the food, and the upper for the birds, with Noah and his family; each ſtory being ſubdivided into different apartments, ſtalls, &c. though Joſephus, Philo, and other commentators, add a kind of fourth ſtory under all the reſt; being, as it were, the hold of the veſſel, to contain the ballaſt and receive the filth and feces of ſo many animals: but F. Calmet thinks, that what is here reckoned a ſtory, was no more than what is called the *keel* of ſhips, and ſerved only for a conſervatory of freſh water. Drexelius makes 300 apartments; F. Fourneir, 333; the anonymous author of the Queſtions on Geneſis, 400; Buteo, Temporarius, Arias Montanus, Hoſtus, Wilkins, Lamy, and others, ſuppoſe as many partitions as there were different ſorts of animals. Pelletier makes only 72, viz. 36 for the birds, and as many for the beaſts. His reaſon is, that if we ſuppoſe a greater number, as 333 or 400, each of the eight perſons in the ark muſt have had 37, 41, or 50 ſtalls to attend and cleanſe daily, which he thinks impoſſible to have been done. But it is obſerved, that there is not much in this: to diminiſh the number of ſtalls without a diminution of animals is vain; it being perhaps more difficult to take care of 300 animals in 72 ſtalls than in 300. As to the number of animals contained in the ark, Buteo computes that it could not be equal to 500 horſes; he even reduces the whole to the dimenſions of 56 pair of oxen. F. Lamy enlarges it to 64 pair of oxen, or 128 oxen; ſo that, ſuppoſing one ox equal to two horſes, if the ark had room for 256 horſes, there muſt have been room for all the animals. But the ſame author demonſtrates, that one floor of it would ſuffice for 500 horſes, allowing nine ſquare feet to a horſe.

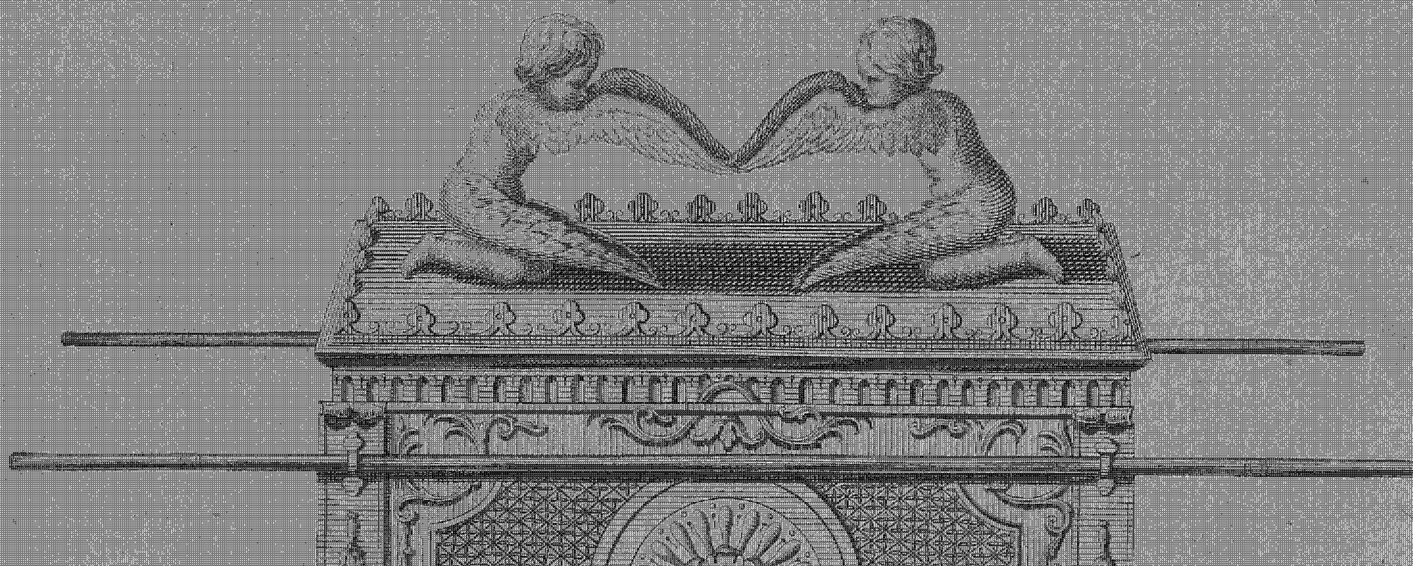
As to the food in the ſecond ſtory, it is obſerved by Buteo from Columella, that 30 or 40 pounds of hay ordinarily ſuffices for an ox a day; and that a ſolid cubit of hay, as uſually preſſed down in our hay ricks, weighs

Noah's Ark. Plate LVII.

floating on the waters of the Deluge.



Ark of the Covenant.



Thackara & Vallance, Sculpt.

weighs about 40 pounds; so that a square cubit of hay is more than enough for one ox in one day. Now, it appears, that the second story contained 150,000 solid cubits; which divided between 206 oxen will afford each more hay, by two-thirds, than he can eat in a year. Bishop Wilkins computes all the carnivorous animals equivalent, as to the bulk of their bodies, and their food, to 27 wolves; and all the rest to 280 beeves. For the former, he allows 1825 sheep; and for the latter, 109,500 cubits of hay: all which will be easily contained in the two first stories, and a deal of room to spare. As to the third story, nobody doubts of its being sufficient for the fowls; with Noah, his sons, and daughters. Upon the whole, the learned bishop remarks, that of the two, it appears much more difficult to assign a number and bulk of necessary things to answer the capacity of the ark, than to find sufficient room for the several species of animals already known to have been there. This he attributes to the imperfection of our list of animals, especially those of the unknown parts of the earth; adding, that the most expert mathematician at this day could not assign the proportion of a vessel better accommodated to the purpose than is here done: and hence he finally concludes, that the capacity of the ark, which had been made an objection against scripture, ought to be esteemed a confirmation of its divine authority; since, in those ruder ages, men, being less versed in arts and philosophy, were more obnoxious to vulgar prejudices than now; so that, had it been an human invention, it would have been contrived according to those wild apprehensions which arise from a confused and general view of things as much too big as it had been represented too little.

But it must be observed, that, besides the places requisite for the beasts and birds, and their provisions, there was room required for Noah to lock up household utensils, the instruments of husbandry, grains and seeds to sow the earth with after the deluge; for which purpose it is thought that he might spare room in the third story for 36 cabbins, besides a kitchen, a hall, four chambers, and a space about 48 cubits in length to walk in.

Plate LVII. fig. 2.

Ark of the Covenant, a small chest or coffer, three feet nine inches in length, two feet three inches in breadth, and two feet three inches in height, in which were contained the golden pot that had manna, and Aaron's rod, and the tables of the covenant. This coffer was made of shittim-wood, and covered with a lid, which was made of solid gold. The ark was reposited in the holiest place of the tabernacle. It was taken by the Philistines, and detained 20, some say 40, years, at Kirjath-jearim; but the people being afflicted with emerods on account of it, returned it with divers presents. It was afterwards placed in the temple.

The lid or covering of the ark was called the *propitiatory* or *mercy-seat*; over which were two figures placed called *Cherubims*, with expanded wings of a peculiar form. Here the Schechinah rested both in the tabernacle and temple in a visible cloud: hence were issued the divine oracles by an audible voice; and the high priest appeared before this mercy-seat once every year on the great day of expiation; and the Jews, wherever they worshipped, turned their faces towards the place where the ark stood.

In the second temple there was also an ark, made of the same shape and dimensions with the first, and put in the same place, but without any of its contents and peculiar honours. It was used as a representative of the former on the day of expiation, and a repository of the original copy of the holy Scriptures, collected by Ezra and the men of the great synagogue, after the captivity. And in imitation of this, the Jews to this day have a kind of ark in their synagogues, wherein their sacred books are reposited. This they call *aron*. Leo of Modena gives a description thereof in his Account of the Customs and Ceremonies of those of his Nation. "The Jews (says he), in the eastern side of their synagogues, have an ark, or armory, called *aron*, in memory of the ark of the covenant. In this are preserved the five books of Moses, written on vellum, with ink made on purpose," &c. Some have supposed that the figure of this ark is still remaining on the triumphal arch of Titus at Rome; though Villalpandus and others, with greater reason, are of opinion, that it is the table of shew-bread. *Prideaux's Con.* Vol. i. p. 209. Tertullian calls this ark *Armarium Judaicum*; whence the phrase, *to be in the armory of the synagogue*, q. d. in the number of canonical writings.

A chest or coffer, very nearly resembling the Jewish ark, and called the *house of the God*, was found in Huaheine, one of the islands in the southern sea. Mr Banks could obtain no other information concerning it than what the name imports. *Hawkesworth's Account*, &c. Vol. ii. p. 252.

ARKLOW, a sea-port town of Ireland, in the county of Wicklow, and province of Leinster. W. Long. 6. 15. N. Lat. 52, 55.

ARLES, a city of Provence in France, seated on the east side of the Rhone, on a hill whose declivity is towards the north. It is an archbishop's see; and is celebrated for its antiquities both within and without the city. Those of which any remains are now to be seen are the amphitheatre, the obelisk, the Elysian Fields, the sepulchres, columns with their capitals, busts, pedestals, aqueducts, with some remains of the capitol, and the temples of their gods. The other ancient monuments are entirely destroyed. Under the amphitheatre. in 1651, they found the statue of venus, which was worshipped by this city; and has been since carried to the castle of Versailles. It is a masterpiece which will always be admired by connoisseurs.

The amphitheatre is one of the most remarkable pieces of antiquity. It was built by the Romans, but the time is unknown though some say by Julius Cæsar. It is of an oval form, and about 400 yards in circumference, and the front is 34 yards in height. The middle, called the *Arena*, is 142 yards wide and 104 broad. The porticos or piazzas are three stories, built with stone of a prodigious size. Each of them consists of 60 arches, which still remain; and the walls are of a surprising thickness, but gone to decay.

The obelisk is the only one of this kind to be seen in France. It seems to be one of the forty brought from Egypt to Rome, because it is of the same oriental granite with them. They are generally full of hieroglyphic characters; but this is quite smooth. In 1675, it was found in a private garden near the walls of the [illegible], not far from the Rhone. It consists of one piece; and is 52 feet high, and 7 in diameter at the base. It is now supported with four lions made of bronze; and on the top a blue ball is placed, with the arms of France, and over that a sun.

The Pagans burying-place, called the *Elysian Fields*, is without the city, upon an agreeable hill, divided into two parts. The first, called *Moulaires*, has very few tombs, they have been broken to build the walls of gardens, which are made in that place. The second, called *Eliscamp*, contains a great number. Those of the Pagans have the letters D. M. which signifies *Diis Manibus*. Those of the Christians have a cross. Pieces of coin of gold, silver, and bronze, are found here; as also urns, lamps, and cups without number.

Here is a royal academy of sciences, consisting of thirty members, who must be natives, gentlemen, and inhabitants of the city. It enjoys the same privileges as that at Paris. Arles is surrounded with marshy land which renders the air full of vapours, and makes it not very wholesome. Long. 4. 48. E. Lat. 43. 40.

ARLEUX, an ancient town of the Netherlands, in Cambresis, with a castle. It was taken by the French in 1645, and retaken by the allies in 1711, but the French got possession again the same month. E. Long. 3. 16. N. Lat. 59. 17.

ARLON, an ancient town of the Netherlands, formerly a strong place, but now dismantled. It belongs to the house of Austria. E. Long. 15. 50. Lat. 49. 4.

ARM, a part of the human body, terminating at one end on the shoulder, and at the other in the hand. See Anatomy, n° 48.

Arm, among sportsmen, is applied to a horse, when, by pressing down his head he endeavours to defend himself against the bit, to prevent his being checked by it. The remedy is, to have a wooden ball covered with velvet, or other matter, put on his chaul, which will so press him between the jaw-bones as to prevent his bringing his head so near his breast.

Arm, in geography, is used for a branch of a sea or river. Italy and Sicily are only parted by an arm of the sea. St George's arm in the Mediterranean is the Thracian Bosphorus.

Arm is also used figuratively for power. The secular arm is the lay or temporal authority of a secular judge; to which recourse is had for the execution of the sentences passed by ecclesiastical judges.

The church sheds no blood: even the judges of inquisition, after they have found the person guilty, surrender him to the secular arm. The council of Antioch, held in 341, decrees, that recourse be had to the secular arm to repress those who refuse obedience to the church: for secular arm, they here use exterior power.

Arm, in respect to the magnet. A loadstone is said to be armed, when it is capped, cased, or set in iron or steel, in order to make it take up the greater weight, and also to distinguish readily its poles. See Magnetism

ARMACALES, a river of Babylon (Abydenus); called *Fossa Regia*, the *Royal Trench* or *Cut* (Polybius); the *Royal River* (Ptolemy); *Almarchur* (Pliny); *Naarmalcha* (Ammian); a factitious channel or cut, made by Nabuchadonosor, and a horn or branch of the Euphrates, (Abydenus). The Euphrates naturally divides into two channels, one passing through Babylon, the other through Seleucia, and then falls into the Tigris: the factitious channel between these two is the Royal River; which mixes with the Tigris, a great deal lower down than Seleucia, at Apamea, (Ptolemy).

ARMADA, a Spanish term, signifying a fleet of men of war. The armada which attempted to invade England in the time of Queen Elizabeth, is famous in history.

This armada, to which the Spaniards in confidence of success, gave the name of *Invincible*, consisted of 150 ships, most of which were greatly superior in strength and size to any that had been seen before. It had on board near 20,000 soldiers and 8000 sailors, besides 2000 volunteers of the most distinguished families in Spain. It carried 2650 great guns, was victualled for half a year, and contained such a quantity of military stores, as only the Spanish monarch, enriched by the treasures of the Indies and America, could supply. The troops on board were to be joined by 34,000 more which the Duke of Parma had assembled in the neighbourhood of Nieuport and Dunkirk. For transporting these, he had, with incredible labour, provided a great number of flatbottomed vessels, and had brought sailors to navigate them from the towns in the Baltic. Most of these vessels had been built at Antwerp; and as he durst not venture to bring them from thence by sea to Nieuport, lest they should have been intercepted by the Dutch, he was obliged to send them along the Scheld to Ghent, from Ghent to Bruges by the canal which joins these towns, and from Bruges to Nieuport by a new canal which he dug on the present occasion. This laborious undertaking, in which several thousand workmen had been employed, was already finished, and the Duke now waited for the arrival of the Spanish fleet; hoping, that as soon as it should approach, the Dutch and English ships which cruised on the coast would retire into their harbours.

When the news reached England that this mighty fleet was preparing to sail, terror and consternation universally seized the inhabitants. A fleet of not above 30 ships of war, and those very small in comparison, was all that was to oppose it by sea. All the commercial towns of England, however, were required to furnish ships for reinforcing this small navy. The citizens of London, instead of fifteen vessels, which they were commanded to equip, voluntarily fitted out double the number; and the gentry and nobility equipped 43 ships at their own charge. Lord Howard of Effingham was admiral; and under him served Drake, Hawkins, and Frobisher, all of them renowned as seamen of courage and capacity. The principal fleet was stationed at Plymouth. A smaller squadron, consisting of 40 vessels, English and Flemish, was commanded by Lord Seymour second son of protector Somerset, and lay off Dunkirk in order to intercept the Duke of Parma.

The land-forces of England were more numerous than those of the enemy, but inferior in discipline and experience. An army of 20,000 men was disposed in different bodies along the south coast, with orders to retire backwards and waste the country, if they could not prevent the Spaniards from landing; 22,000 foot and 1000 horse, under the command of the Earl of Leicester, were stationed at Tilbury, in order to defend the capital; and the principal army, consisting of 34,000 foot and 2000 horse, commanded by Lord Hunsdon

Armada. Hunsdon, was reserved for guarding the Queen's person, and appointed to march whithersoever the enemy should appear. These armies, though all the Spanish forces had been able to land, would possible have been sufficient to protect the liberties of their country. But as the fate of England, in that event, must depend on the issue of a single battle, all men of serious reflection entertained the most awful apprehensions of the shock of at least 50,000 veterans, commanded by experienced officers, under so consumate a general as the Duke of Parma. The Queen alone was undaunted. She issued all her orders with tranquillity, animated her people to a steady resistance, and employed every resource which either her domestic situation or her foreign alliances could afford her. She even appeared on horseback in the camp at Tilbury; and riding through the lines, discovered a cheerful and animated countenance, exhorted the soldiers to remember their duty to their country and their religion, and professed her intention, though a woman, to lead them herself into the field against the enemy, and rather perish in battle than survive the ruin and slavery of her people. "I know (said she, intrepidly) I have but the weak and feeble arm of a woman; but I have the heart of a king, and of a king of England too!" The heroic spirit of Elizabeth communicated itself to the army, and every man resolved to die rather than desert his station.

The Spanish armada was ready in the beginning of May; but its sailing was retarded by the death of the Marquis of Santa Croce the admiral, and that also of the vice-admiral the Duke of Paliano. The command of the expedition was therefore given to the Duke of Medina Sidonia, a man entirely unexperienced in sea affairs. This promotion, in some measure, served to frustrate the design, which was also rendered less successful by some other accidents. Upon leaving the port of Lisbon, the armada next day met with a violent tempest, which sunk some of the smallest of their shipping, and obliged the fleet to put back into the harbour. After some time spent in refitting, they put again to sea. Being descried by Fleming, a Scottish pirate, who was roving in those seas, he immediately sailed towards the English fleet, and informed the admiral of their approach. Effingham had just time to get out of port when he saw the Spanish armada coming full sail towards him, disposed in the form of a crescent, and stretching the distance of seven miles from the extremity of one division to that of the other. The English admiral, considering that the Spaniards would probably be much superior to him in close fight, by reason of the size of their ships and the number of their troops, wisely resolved to content himself with harassing them in their voyage, and with watching attentively all the advantages which might be derived from storms, cross winds, and such like fortuitous accidents. It was not long before he discerned a favourable opportunity of attacking the vice-admiral Recaldo. This he did in person; and on that occasion displayed so much dexterity in working his ship, and in loading and firing his guns, as greatly alarmed the Spaniards for the fate of the vice-admiral. From that time they kept much closer to one another; notwithstanding which, the English on the same day attacked one of the largest galeasses. Other Spanish ships came up in time to her relief; but in their hurry one of the principal galleons, which had a great part of the treasure on board, ran foul of another ship, and had one of her masts broken. In consequence of this misfortune she fell behind, and was taken by Sir Francis Drake; who on the same day took another capital ship, which had been accidentally set on fire.

Several other rencounters happened, and in all of them the English proved victorious, through the great advantage which they derived from the lightness of their ships, and the dexterity of the sailors. The Spaniards in that age did not sufficiently understand nautical mechanics, to be able to avail themselves of the unusual magnitude of their ships. The English sailed round them, approached, or retired, with a velocity that filled them with amazement, and did infinitely greater execution with their cannon: for while every shot of theirs proved effectual, their ships sufferd very little damage from the enemy, whose guns were planted too high, and generally spent their force in air.

The Spaniards, however, still continued to advance till they came opposite to Calais; there the Duke de Medina having ordered them to cast anchor, he sent information to the Duke of Parma of his arrival, and intreated him to hasten the embarkation of his forces. Farnese accordingly began to put his troops on board. But at the same time he informed Medina, that, agreeably to the King's instructions, the vessels which he had prepared were proper only for transporting the troops, but were utterly unfit for fighting; and for this reason, till the armada were brought still nearer, and the coast cleared of the Dutch ships which had blocked up the harbours of Nieuport and Dunkirk, he could not stir from his present station, without exposing his army to certain ruin, the consequence of which would probably be the entire loss of the Netherlands.

In compliance with this request, the armada was ordered to advance; and it had arrived within sight of Dunkirk, between the English fleet on the one hand, and the Dutch on the other, when a sudden calm put a stop to all its motions. In this situation the three fleets remained one whole day. About the middle of the night a breeze sprung up; and Lord Howard had recourse to an expedient which had been happily devised on the day before. Having filled eight ships with pitch, sulphur, and other combustible materials, he set fire to them, and sent them before the wind against the different divisions of the Spanish fleet.

When the Spaniards beheld these ships in flames approaching towards them, it brought to their remembrance the havock which had been made by the fire-ships employed against the Duke of Parma's bridge at the siege of Antwerp. The darkness of the night increased the terror with which their imaginations were overwhelmed, and the panic flew from one end of the fleet to the other. Each crew, anxious only for their own preservation, thought of nothing but how to escape from their present danger. Some of them took time to weigh their anchors, but others cut their cables and suffered their ships to drive with blind precipitation, without considering whether they did not thereby expose themselves to a greater danger than that which they were so solicitous to avoid. In this confusion the ships

ships ran foul of one another: the shock was dreadful, and several of them received so much damage as to be rendered unfit for future use.

When day-light returned, Lord Howard had the satisfaction to perceive that his stratagem had fully produced the desired effect. The enemy were still in extreme disorder, and their ships widely separated and dispersed. His fleet had lately received a great augmentation by the ships fitted out by the nobility and gentry, and by those under Lord Seymour, who had left Justin de Nassau as alone sufficient to guard the coast of Flanders. Being bravely seconded by Sir Francis Drake and all the other officers, he made haste to improve the advantage which was now presented to him, and attacked the enemy in different quarters at the same time with the utmost impetuosity and ardour. The engagement began at four in the morning, and lasted till six at night. The Spaniards displayed in every rencounter the most intrepid bravery; but, from the causes already mentioned, they did very little execution against the English, while many of their own ships were greatly damaged, and twelve of the largest were either run aground, or sunk, or compelled to surrender.

It was now evident that the purpose of the armada was utterly frustrated. The Spanish admiral, after many unsuccessful rencounters, prepared therefore to make his way home; but as the winds were contrary to his return through the channel, he resolved to take the circuit of the island. The English fleet followed him for some time; and had not their ammunition fallen short through the negligence of the public offices in supplying them, they had obliged the armada to surrender at discretion. Such a conclusion of that vain-glorious enterprize would have been truly illustrious to the English, but the event was scarce less fatal to the Spaniards. The armada was attacked by a violent storm in passing the Orkneys; and the ships, having already lost their anchors, were obliged to keep at sea, while the mariners, unaccustomed to hardships, and unable to manage such unwieldly vessels, allowed them to drive on the western isles of Scotland, or on the coast of Ireland, where they were miserably wrecked. Not one half of the fleet returned to Spain, and a still smaller proportion of the soldiers and seamen; yet Philip, whose command of temper was equal to his ambition, received with an air of tranquillity the news of so humbling a disaster. "I sent my fleet (said he) to combat the English, not the elements. God be praised that the calamity is not greater!" This calamity, however, was sensibly felt all over Spain, and there was scarcely a single family of rank in the kingdom that did not go in mourning for the death of some near relation; insomuch that Philip, dreading the effect which this universal face of sorrow might produce upon the minds of the people, imitated the conduct of the Roman senate after the battle of Cannæ, and published an edict to abridge the time of public mourning.

ARMADILLA, in the Spanish America, denotes a squadron of men of war, to the number of six or eight, from twenty-four to fifty pieces of cannon, which the king maintains, to prevent foreigners from trading with the Spaniards and the Indians, both in time of war and peace.

The vessels of this armadilla are those that have been so much talked of under the name of *guarda costas*. They have even power to take all Spanish merchant-ships they meet with on the coasts that have not licences from the king.

The South sea has its armadilla as well as the North sea. The ordinary abode of the former are at Calao, a port of Lima; that of the latter at Carthagena.

ARMADILLO, in zoology, a synonime of the dasypus. See DASYPUS.

ARMAGEDDON, a place spoken of in the Revelations (xvi. 16.), which literally signifies the mountain of Mageddon or Megiddo, a city situated in the great plain at the foot of mount Carmel, where king Josiah received his mortal wound in the battle against Necho king of Egypt. At Armageddon, the three unclean spirits, coming out of the dragon's mouth, shall gather together the kings of the earth to the battle of the great day of God Almighty (Rev. xvi. 13,14). The word Armageddon, according to Mr Pool, does not signify any particular place, but is here an allusion, as some think, to that of Megiddo, mentioned Judges v. 19. where Barak overcame Sisera with his great army, and where Josiah was slain (2 Kings xxiii. 30). Others translate this word, *the mountain of the gospel*, and others *the mountain of apples or fruits*.

ARMAGH, a county of Ireland, bounded by Louth on the south; Lough-neagh, on the north; Tyrone and Monaghan, on the west; and Down, in part, on the east, from which it is separated by the river Newry. It is in length 32 miles, in breadth 17; and is divided into five baronies, containing about 170,620 acres. Both the air and soil are good, especially the latter, which is said to be the richest in Ireland; only there is a certain tract in it called the *Fewes*, that is, *hilly* and *barren*. The members it sends to parliament are six, viz. two for the city of Armagh, two for the county, and two for the borough of Charlemont.

Armagh, standing near the river Kalin, gives name to the country, and is the see of the primate of all Ireland. It is said to have been founded by St Patrick in the fifth century; and in 1142, it was constituted an archbishoprick, together with Dublin, Cashel, and Tuam, by cardinal Papyreo, with the consent of the king, dukes, bishops, abbots, and states of Ireland. This Papyreo was sent into Ireland by Pope Eugenius, to reform the abuses that had crept into the church-discipline of that country. Here was anciently a famous monastery built by St Columbo, or Columbanus, about the year 610. The cathedral was often burnt, but as often rebuilt and enlarged, and particularly by Patrick Scanlain, about 1262. His successor Nicholas, son of Molissa, beside books, rich ecclesiastical vestments, and other things, bestowed on it an annual pension of twenty marks. He appropriated also to his see the manor of Dromyskin. He died the 10th of May, 1303. This town was first subjected to the English by John de Courcy; but afterwards entirely destroyed by Tir Oen, or O'Neal, in Queen Elizabeth's time. However, it was afterwards recovered, rebuilt, and garrisoned by the English.

The see of Armagh is valued in the king's books, by an extent taken *anno* 30th Henry VIII. at L. 183, 17 : 5¼ Irish money *per annum*, which amounts to

L. 137 : 18 : 0¾ (the difference between Irish and Sterling money being at that time one-fourth). But by an extent returned in the 15th of James I. it is valued at L.400 Sterling *per annum*, and pays so much first fruits to this day. It is reputed to be worth annally L.8000. The chapter of Armagh is composed of five dignitaries and four prebendaries, who have voices in every capitular act. The dignitaries are thus ranked, viz. a dean, chapter, chancellor, treasurer, and archdeacon. There are also eight vicars choral, and an organist, attendant on the service of the cathedral. The vicars choral were anciently fewer; and of the number only one priest. Primate Marsh added another priest, but without increasing the number of vicars. In the year 1720, Primate Lindsay obtained a new charter for enlarging the number of the said vicars to eight, and laid out upwards of L.4000 on a purchase, in augmentation of the estate of the choir.

ARMAGNAC, a province of Guienne in France, 55 miles in length, and 40 in breadth; bounded on the east by the river Garonne, on the south by Bigorre and Bearn, and on the west by Gascony, and on the north by Condomois and Agenois: Auch is the capital town. It is fertile in corn and wine, and carries on a considerable trade in brandy, wool, and bonchretien pears, which are excellent.

ARMAMAXI, in antiquity, a kind of Scythian chariots or carriages, composed of two wheels, variously adorned with crowns, shields, breast-plates, and other spoils, carried in procession after the images of the gods and great men.

ARMAMENT, a large body of forces, raised and provided with the furniture of war, either for land or sea service.

ARMATURA, in a general sense, is the same with what we otherwise call armour.

ARMATURA is more particularly used in the ancient military art, for a kind of exercise, performed with missive weapons, as darts, spears, arrows, and the like. In this sense, armatura stands contradistinguished from palaria; the latter being the exercise of the heavy-armed, the former of the light-armed.

The armatura was practised with great diligence among the Romans: they had their *campidoctores*, on purpose to instruct the *tyrones* or young soldiers in it. Under it were included the throwing of the spear or javelin, shooting with bows and arrows, &c.

ARMATURA is also an appellation given to the soldiers who were light-armed.

ARMATURA is also a denomination given to the soldiers in the emperor's retinue. Of these we find two schools, mentioned in the *Notitia imperii*, called the *armaturæ seniores* and *armaturæ juniores*. Their commander was intitled *tribunus armaturarum*.

ARMED, in the sea-language. A cross-bar shot is said to be armed, when some rope-yarn or the like is rolled about the end of the iron-bar, which runs thro' the shot.

ARMED, in heraldry, is used when the horns, feet, beak, or talons, of any beast or bird of prey, are of a different colour from the rest of their body.

Armed-Ship, a vessel occasionally taken into the service of the government in time of war, and employed to guard some particular coast, or attend on a fleet. She is therefore armed and equipped in all respects like a ship of war, and commanded by an officer of the navy, who has the rank of master and commander. All ships of this sort are upon the establishment of the king's sloops, having a lieutenant, master, purser, surgeon, &c.

ARMENE, or ARMINA, anciently a hamlet of Paphlagonia, (Ptolemy). The inhabitants encompassed it with a wall, because of the coldness of the place, imagining by that means to render it warmer. But this proving ineffectual, gave rise to the proverb *Armenen muro cingere*, used to express some egregious folly.

ARMENIA, a country of Asia, anciently divided into Armenia Major and Minor. Armenia Major according to Strabo, was bounded on the south, by mount Taurus, which separated it from Mesopotamia; on the east, by the two Medias; on the north, by Iberia and Albania, or rather that part of mount Caucasus which surrounds them both; and on the west, by Armenia Minor, or the mountains of Paryadres, some Pontic nations, and the Euphrates. The most considerable cities were Artaxata, Tigranocerta, and Thedosiopolis. —Armenia Minor was bounded on the east, by the Euphrates; on the south, by mount Taurus, which separated it from Cilicia; on the west and north, by a long chain of mountains called in different places *Mons Scordiscus*, *Amanus*, and *Antitaurus*, by which it was separated from Cappadocia.

Whence this tract received the name of *Armenia* is not determined. The Greeks suppose it to be so called from one *Armenus*, who attended Jason in the Argonautic expedition, and afterwards settled in this country. Others, transforming Armenia into Aramia, derive its name from Aram the son of Shem, or from one of the kings of Armenia bearing that name. Bochart imagines it to be a contraction or compound of *Aar*, a Hebrew word signifying a "mountain," and *Mini* signifying "metal," and which was the name of a province of Armenia mentioned by the prophet Jeremiah.

Herodotus derives the ancient Armenians from the Phrygians, by reason that several Phrygian words were crept into the ancient Armenian language. But Strabo reckons them to have been originally Syrians, which Bochart looks upon to be the most probable opinion.

Armenia is said to have been very early advanced to the honour of a kingdom. Berosus makes one Sytha the first founder of this monarchy, whose successor Bardanes, he says, was driven out by Ninus king of Assyria. Plutarch mentions one Araxes king of Armenia, who in a war with the Persians, being assured of success by an oracle, provided he sacrificed his two daughters, caused the two daughters of one Miesalcus, a nobleman of his court, to be sacrificed in their stead, flattering himself that he thereby complied with the oracle. But Miesalcus, did not fail to revenge the death of his own daughters by putting the king's two daughters to death, and pursued himself so closely, that he was drowned in attempting to swim across the Araxes, which was then called *Helmus*.

The Armenians were in process of time subdued by the Medes, to whom Astyages made them tributaries, but allowed them to be governed by their own kings; but on the dissolution of the Median empire by Cyrus, the kingdom was reduced to the form of a province, and they were governed by Persian prefects or lieutenants. On the destruction of the Persian empire by

Alexander the Great, Armenia fell into the hands of the Macedonians; to whom it continued subject till the beginning of the reign of Antiochus the Great. This prince having appointed two prefects called *Zadriades* and *Artaxias* to govern Armenia, they excited the people to a revolt, and caused themselves to be proclaimed kings of the provinces over which they presided. Antiochus being then very young, they were attended with success beyond their expectation; which encouraged them to attempt the enlargement of their territories. Accordingly, invading the neighbouring countries, they took from the Medes the provinces of Caspiana, Phaunitis, and Basoropida; from the Iberians, Chorzena and Gogorena on the other side of the Cyrus; from the Chalybes and Mossynæci, the provinces of Pareneta and Herexena, which bordered on Armenia Minor.

On this occasion, the abovementioned division of the kingdom into Armenia Major and Minor first took place. Artaxias became king of Armenia Major, and Zadriades of Armenia Minor; and this distinction subsists even at this day.

By whom Artaxias was succeeded is not known; neither have we any account of the transactions of his reign, farther than that Antiochus led a powerful army against him and Zadriades, but without being able to recover a single province. Upon this he concluded a peace, designing to fall upon them at a proper opportunity; but they having entered into alliance with the Romans, by that means secured themselves in the possession of their kingdom. After this, Artaxias was defeated and taken prisoner by Antiochus Epiphanes; but some how or other, seems to have been restored to his kingdom.

From this time we meet with a chasm in the Armenian history for 70 years; during which all we know is, that Tigranes, the king's son, was delivered up as an hostage to the Parthians; from whence it is plain, that the Armenians had been carrying on an unsuccessful war with that nation. On the news of his father's death, however, the Parthians set the young king at liberty, having first obliged him to give up a considerable part of his kingdom by way of ransom.

Tigranes, being thus restored to his father's kingdom, was prevailed upon in the beginning of his reign to enter into an alliance with Mithridates Eupator against the Romans, whose power began to give jealousy to all the princes of Asia. One of the articles of this treaty was, that Mithridates should have the cities and conquered countries, and Tigranes the captives and plunder. In consequence of this, Tigranes was to invade Cappadocia, which he had lately been obliged, by a decree of the senate of Rome, to give up to Ariobarzanes. But before either of the princes took the field, a marriage was solemnized with all possible magnificence between Tigranes and Cleopatra the daughter of Mithridates.

Immediately after the nuptials, Tigranes set out on his intended expedition; and Ariobarzanes, on the first news of his march, abandoned his kingdom and fled to Rome. Thus Tigranes, without fighting a stroke, enriched himself with the booty, and then proclaimed Ariarathes, Mithridates's son, king of Cappadocia, to the universal satisfaction of the people.

In the mean time the Syrians being harrassed with a long and intestine war of the Seleucidæ, invited Tigranes to come and take possession of their country; which he accordingly did, and kept it for 18 years, till he was driven out by Pompey, and Syria reduced to the form of a Roman province. Encouraged by this success, he next invaded Armenia Minor; defeated and killed king Artanes, who opposed him with a considerable army; and in one campaign made himself master of the whole kingdom. From Armenia Minor he marched against the Asiatic Greeks, the Adiabenians, the Assyrians, and the Gordians, carrying all before him, and obliging the people wherever he came to acknowledge him sovereign. From this second expedition he returned home loaded with booty, which he soon after increased by the spoils of Cappadocia, invading that kingdom a second time at the instance of Mithridates, who had been obliged by the Romans to withdraw his forces from thence. From Cappadocia, Tigranes, besides other booty, brought back into Armenia, no fewer than 300,000 captives, having surrounded the country with his numerous forces in such a manner that none could escape. These, together with the prisoners he had taken in his two first expeditions he employed in building the city of Tigranocerta, which they afterwards peopled.

In the mean time Mithridates, who had concluded a peace with the Romans for no other end than to gain time, sent a solemn embassy to Tigranes, inviting him to enter into a second alliance against the common enemy. This he at first declined, but in the end was prevailed upon by his wife Cleopatra to send him considerable supplies, though he never came heartily into the war, not caring to provoke the Romans, who on their part kept fair with him, taking no notice for the present of the supplies he had sent Mithridates. That unfortunate prince being soon after defeated by Lucullus, was forced to fly for shelter into Armenia, where he met with a very cold reception from his son-in-law, who would neither see him, treat with him, nor own him as his relation: however, he promised to protect his person, and allowed him in one of his castles a princely retinue, and a table suitable to his former condition.

Though this total overthrow of Mithridates might have opened the eyes of Tigranes, and made him oppose with all his might the growing power of the Romans, he foolishly left them to finish their conquest of Pontus, while he marched at the head of a very numerous army against the Parthians, with a design to recover from them the dominions they had formerly extorted from him before they set him at liberty. These he easily retook; and, not satisfied with what formerly belonged to him, he added to them all Mesopotamia, the countries that lay about Ninus and Arbela, and the fruitful province of Migdonia; the Parthians, tho' at that time a mighty people, flying every where before him. From Mesopotamia Tigranes marched into Syria to quell a rebellion which had been raised by Cleopatra surnamed *Selene;* who, after the death of her husband Antiochus Pius, reigned jointly with her sons in that part of Syria which Tigranes had not seized on. The malcontents were quickly reduced; and the queen herself was taken prisoner, and confined to the castle of Seleucia, where she was soon after put to death by the king's orders. From Syria Tigranes passed

Armenia. ed into Phœnice, which he subdued either entirely or in great part, spreading far and wide the terror of his arms, insomuch that all the princes of Asia, except those who were in alliance with the Romans, either in person, or by their deputies, submitted and paid homage to the conqueror.

The king, having now subdued all Syria to the borders of Egypt, and being elated with a long course of victories and prosperous events, began to look upon himself as far above the level of other crowned heads. He assumed the title of *King of kings*, and had many kings waiting upon him as menial servants. He never appeared on horseback without the attendance of four kings dressed in livery, who run by his horse; and when he gave answers to the nations that applied to him, the ambassadors stood on either side the throne with their hands clasped together, that attitude being of all others then accounted among the orientals the greatest acknowledgment of vassalage and servitude. In the midst of all this haughtiness, however, he was unexpectedly visited by an ambassador from Lucullus the Roman general, who without any ceremony told him, that he came to demand Mithridates king of Pontus, who had taken refuge in his dominions, and, in case of his refusal, to declare war against him. Notwithstanding his high opinion of himself, Tigranes returned a mild answer to this message: in which, however, he refused to deliver up his father-in-law; and being highly provoked at Lucullus for not giving him the title of *King of kings* in his letter, he did not so much as bestow upon him the title of *general* in his answer. In the mean time, being informed that Zarbienus king of the Gordians had entered into a private alliance with the Romans, he put him, his wife, and children, to death; and then, returning into Armenia, received with the greatest pomp imaginable his father-in-law Mithridates, whom to that time he had not admitted into his presence, though he had resided a year and eight months in his dominions. They had several private conferences; and at last Mithridates was sent back to Pontus with 10,000 horse, to raise there what disturbances he could.

Lucullus, on the other hand, hearing the king's resolution to protect Mithridates, immediately began his march for Armenia, at the head of only two legions of foot and 3000 horse, having left 6000 men in Pontus to keep that country quiet. Having passed the Euphrates without opposition, he detached two parties; one to besiege a city where he heard that Tigrane's treasure and concubines were kept; and the other under Sextilius, to block up Tigranocerta, in order to draw the king to a battle. But Tigranes, after having put to death the scout that brought him the first intelligence of the approach of the Romans, made towards Mount Taurus, which he had appointed for the place of the general rendezvous. The Roman general then dispatched Muræna in pursuit of the king; who having overtaken him in a narrow pass, defeated him, and, besides all the baggage, carried off a great many prisoners, the king himself having fled in the beginning of the skirmish. After this, he sent out several parties to scour the country, in order to prevent the innumerable forces of Tigranes from joining into one body. This, however, he was not able to effect: Tigranes was joined by such numbers of Gordians, Medes, Adiabenians, Albanians, Iberians, &c. that, before he left Mount Taurus, his army consisted, according to Plutarch, of 150,000 foot armed cap-a-pee, 35,000 pioneers, 20,000 archers and slingers, and 55,000 horse.

Lucullus was so far from being dismayed at this formidable army, that the only fear he had was lest the king should follow the advice of Mithridates, which was not to engage the Romans, but, by ravaging the country, distress them for want of provisions. In order to draw him to a battle, therefore, he formed the siege of Tigranocerta, imagining that Tigranes would never suffer that fine city to be taken without making any attempt to relieve it. The event fully answered his expectations: Tigranes having called a council of war, it was unanimously resolved to attack the Romans; and Taxilis, whom Mithridates sent to dissuade the king from venturing a battle, was in danger of losing his head on account of the advice he gave. The Roman general, finding Tigranes disposed to come to an engagement, left Muræna with 6000 men to carry on the siege, while he himself marched against the king's vast army with only 10,000 men, according to some, and the highest computations make them no more than 18,000. The Romans were at first greatly disheartened; but being encouraged by Lucullus, they immediately broke the Armenian army, who betook themselves to flight almost at the first onset. The Romans pursued them till night, making a most terrible slaughter. Plutarch informs us, that of the Armenians 100,000 foot were killed, and that very few of the cavalry escaped; whereas of the Romans only five men were killed and 100 wounded. Antiochus the philosopher, mentioning this battle, says, that the sun never beheld the like; and Livy, that the Romans never fought at such a disadvantage; the conquerors not amounting to a twentieth-part of the conquered. Tigranes in his flight having met with his son in as forlorn a condition as himself, resigned to him his royal robes and diadem, desiring him to shift for himself and save those royal ensigns. The young prince delivered them to a trusty friend, who, being taken by the Romans, consigned them to Lucullus.

While the king was making his escape after this terrible overthrow, he was met by Mithridates, who was marching to his assistance at the head of a considerable army. The king of Pontus cheered up his son-in-law as well as he could, and encouraged him to continue the war: advising him, instead of fruitlessly bewailing the present disaster, to rally his troops, raise new supplies, and renew the war, not questioning but that in another campaign he might repair all the losses he had sustained: but while the two kings were consulting upon these matters, Lucullus made himself master of Tigranocerta. From this city he marched into the small kingdom of Gordyene, where he celebrated, with the utmost pomp, the obsequies of king Zabienus, whom Tigranes had put to death, lighting the funeral-pile with his own hands. In this kingdom, besides immense sums of gold and silver, he met with such store of provisions as enabled him to carry on the war without putting the republic to any charge.

The two kings, having levied new forces, appointed their troops to rendezvous in the spacious plains on the other side of Mount Taurus; whereupon Lucullus, leaving Gordyene, and passing by Mount Taurus, encamped close by the enemy. Several skirmishes happened for some time between the two armies without any

any considerable advantage; but Lucullus could by no means draw them to a general engagement. Upon this he decamped, as if he designed to march to Artaxata and lay siege to that place, where Tigranes had left his wife and children, with great part of his treasures. He had scarce formed his camp when the enemy appeared, and sat down close by him. Lucullus did not allow them to fortify their camp, but immediately attacked them, and having put them to flight after a faint resistance, pursued them all night with great slaughter, took most of the chief officers prisoners, and returned the next day loaded with booty.

The Roman soldiers now, finding the cold very severe, though it was no later in the year than the autumnal equinox, requested their general to allow them to retire into winter-quarters. This request he rejected with indignation; upon which they mutinied. Lucullus did all he could to persuade them to continue in their duty; and prevailed so far that they consented to lay siege to Nisibis in hopes of booty. This place they took; and Lucullus, to the great satisfaction of his troops, took up his winter-quarters there. The next year, however, his forces again mutinied, accusing him of amassing immense wealth for himself; and throwing their empty purses at his feet, told him, that as he enriched himself alone, he might carry on the war by himself. He endeavoured to appease them as much as possible; but the sedition being fomented by a party who favoured Pompey the great, at that time aspiring to the command of Lucullus's army, the latter found himself obliged to sit still and see Mithridates and Tigranes over-run Cappadocia, and recover all Armenia and great part of Pontus. They would have gained much greater advantages, had not a son of Tigranes taken arms against his father, and obliged him to divide his troops. The father and son coming to a pitched battle, the latter was defeated, and forced to save himself in Parthia, where he persuaded Phrahates, king of that country, to assist him with a numerous army against his father. Phrahates having laid siege to Artaxata, Tigranes the elder was obliged to hide himself in the mountainous parts of his kingdom; upon which the king of Parthia returned home. Of this Tigranes the father being apprised, he immediately abandoned the fastnesses of the mountains; and, falling upon his son at Artaxata, dispersed the rebels with great slaughter; and entered his metropolis in triumph. Tigranes the son first fled to Mithridates; but finding him reduced to great straits, having been overcome a few days before, with the loss of 40,000 men, by Pompey, he went over to the Romans, and led them into Armenia against his father as an ally of Mithridates.

Tigranes, being now quite dispirited, and unable to make head against the Romans, resolved at once to submit. Accordingly he waited on Pompey in his camp, and having delivered his sword to two lictors, prostrated himself before him, and laid his diadem at his feet. Pompey, however, gave him a gracious reception, restored him the kingdom of Armenia, but fined him of 6000 talents for making war on the Roman people without cause. As the king had appealed to the Roman general for justice against his son, Pompey heard both parties the next day, and made the son governor of Gordyene and Sophene; but the treasures that were kept in the latter he adjudged to the father, because without them he could not pay the fine. The son, being thus disappointed, endeavoured first to make his escape, and afterwards, by private messengers, solicited the inhabitants not to deliver up the treasures to his father. This being taken very much amiss by Pompey, he caused him to be kept in irons; and even then he found means to stir up Phrahates king of Parthia, whose daughter he had married, against the Romans, and to form a conspiracy against his father's life, whereupon Pompey sent him in chains to Rome, where he was kept prisoner in the house of L. Flavius a senator, till the tribuneship of P. Clodius, who, being bribed with a large sum of money, set him at liberty in spite of Pompey and the senate.

Tigranes being now thoroughly humbled, willingly yielded to the Romans Cappadocia, Syria Cilicia, and that part of Phœnice which he possessed, contenting himself with his paternal kingdom; and not only paid the fine laid upon him, but made large presents to Pompey, and all the officers of his army, which procured him the title of *the friend and ally of the Roman people*. He afterwards entered into a war with Phrahates king of Parthia, by whom he was overcome, and would have been driven out of his kingdom, had not a peace been brought about by the mediation of Pompey. He ever after cultivated a strict friendship with the Romans; insomuch that he not only refused to receive Mithridates, who fled to him after he had been routed by Pompey near Mount Stella, but even offered a reward of 100 talents to any one that would put him to death. His second son also, by name Sariaster, took up arms against him; but, by the assistance of the Romans, that rebellion was soon quelled. He died in the 85th year of his age; and was succeeded by his son Artuasdes, called by Josephus *Artabazes*, by Orosius *Artabanes*, and by others *Artoadistes*.

From this time to the time of Trajan Armenia was governed by its own kings; but as they were plainly vassals to the Romans, though they did not take that title till the reign of the emperor Nero, their history falls to be considered under that of the Romans.

By Trajan the kingdom of Armenia Major was reduced to the form of a Roman province; but it soon recovered its liberty, and was again governed by its own kings in the reigns of Constantine the Great, and his successor, to whom the kings of Armenia were feudatories. In the reign of Justin II. the Saracens subdued and held till the irruption of the Turks, who possessed themselves of this kingdom, and gave it the name of *Turcomania*. The Turks, after the reduction of Armenia, invaded Persia, and other countries subject to the emperors of the east; which gave the Armenians an opportunity of shaking off the Turkish yoke, and setting up kings of their own, by whom they were governed till the country was again subdued by Occadan, or, as some style him, *Heccata*, the son of Cingis, and first cham of the Tartars. Neither was the conquest of Armenia by the Tartars so absolute as to extirpate the race of their kings; seeing we read of Haithon, surnamed the *Armenian*, reigning some time after, and going in person to treat with Mungo, the great cham of Tartary, of the concerns of his kingdom; and in our chronicles we find mention made of

Armenia. Leo king of Armenia, who, in the reign of Richard II. came into England to sue for aid against the Turks, by whom he had been driven from his kingdom. In the year 1472 of the Christian æra, Uſſan Caſſanes king of Armenia succeeding to the crown of Persia, made Armenia a province of that empire; in which state it continued till the year 1522, when it was subdued by Selim II. and made a province of the Turkish empire. Some say that Selim I. reduced it on his return from Persia, where he had gained a complete victory over the great Sophi Ismael. But Sansovin assures us, that in the reign of Selim I. who died in 1520, both the Lesser and Greater Armenia had their own kings; and adds, that Selim caused the head of the king of the Lesser Armenia to be cut off and sent to Venice as a mark of his victory. We read no where else of any kings of Armenia after it became a province of Persia. Be that as it will, the Turkish annals cited by Calvisius inform us, that Selim II. conquered Armenia in 1522, since which time it has ever continued subject to the Turks, except the eastern part, which the Persians are masters of to this day.

Concerning Armenia Minor we find very little recorded, except what has been already mentioned, and what falls under the Roman history. It was made a Roman province by Vespasian, continued so till the division of the empire, when it was subjected to the emperors of the east; and, on the decline of their power, was subdued first by the Persians, and afterwards by the Turks, who gave it the name of *Genech*, and have kept it ever since.

This country is still divided into the Great and Small. Great Armenia comprehends what is now called *Turcomania*. It has Georgia on the north, from which it is separated by high mountains; the river Euphrates on the west; Diarbeker, Curdistan, and Aderbijan, on the south; and Shirvan on the east. The chief towns in that part of Armenia belonging to Turky are, Arzum the capital, near the springs of the Euphrates, a large city, and a great thoroughfare for the caravans between Turky and Persia; Kara, a strong city, head of the government of the same name; Bayazid, a republic of Hurds, near mount Ararat: Baha, another republic of the same; and Van or Wan, on the lake Van, the head of a government of the same name; with other towns of less note. That part of Armenia subject to Persia is chiefly contained in the province of Aran, in which are several fine towns; as, Erivan or Rivan, the capital of the whole; Ganjals, one of the finest cities in Persia, in the north of the province, near the Kur; Kapan, on the south side, near the Aras; besides Nakchivan, Astabad Sulfa, Ordabad, Baylakan or Pilkan, on the Aras; Berdah and Shilkah on the Kur.

The country in general is full of mountains and valleys, lakes, and rivers; particularly the country about the three churches, near Erivan, is admirably fine, being full of rivulets, which render it extremely fruitful. Besides great quantities of all sorts of grain, here are fields of a prodigious extent covered with tobacco: but it is not a native of the place, though supposed by some to be the terrestrial paradise; for it all came originally from America. The rest of the country produces rice, cotton, flax, melons, and grapes: in short, there is nothing wanting but olives; which is by some thought to prove that the ark could not rest on mount Ararat, because the dove brought an olive branch in her mouth, and this tree never leaves a place where it once grew. It seems, however, to have been otherwise anciently; for Strabo tells us, that the olive grew in Gogarene, a province of Armenia. They got oil to burn from the ricinus, and use linseed oil in the kitchen. The water-melons are as cool as ice in the hottest day, and melt in the mouth: the best are produced in the salt-lands, near the three churches and the river Aras. After rain, the sea-salt lies in crystals upon the fields, and even crackles under the feet. About ten miles from the three churches, in the road to Teflis, there are pits or quarries of fossile salt, which yield enough to supply all Persia, without being exhausted: they cut it into large pieces like stone, and each buffalo carries two of them; the mountain from whence it is dug is nothing but a mass of salt, which appears like a rock of silver, when the sun shines, on the places not covered with earth.

This country has been remarkable for its extreme cold from the remotest antiquity: Sir John Chardin tells us, that he found ice in the rivulets in the mornings even of the month of July. In many places, also, if they had not the convenience of watering their grounds, they would be almost entirely barren.

The Armenians are an honest, civil, polite people, scarce troubling themselves about any thing else but trade, which they carry on in most parts of the world, by which means they have spread themselves over the east, and also great part of Europe; and wherever they come, commerce is carried on with spirit and advantage.

The religion of the Armenians is the Christian, of the Eutychian sect: that is, they own but one nature in Jesus Christ; and when they speak of the hypostatical union, that he is perfect God and perfect man without mixture. They have a high esteem for a book they call the *Little Gospel*, which treats of the Infancy of Jesus, and says that the Virgin Mary being pregnant, her sister Salome accused her of having prostituted herself; to which the Virgin answered, that she needed only to lay her hand on her belly, and she would know how she came to be with child; this Salome accordingly did, and fire came out of her belly, which consumed the half of her arm; upon which she acknowledged her fault, and drew it back: after which it was healed by putting it to the same place.

The Armenian clergy consist of patriarchs, archbishops, doctors, secular priests, and monks. The secular priests are not allowed to marry a second time; and therefore they take care to choose young healthy wives: they maintain themselves and families by following some occupation, insomuch that they have hardly time to perform their ecclesiastical functions: they lie in the churches on the vigils of those days they are obliged to officiate.

The Armenian monks are of the order of St Basil; and every Wednesday and Friday they eat neither fish nor eggs, nor oil, nor any thing made of milk, and during Lent they live upon nothing but roots: they are allowed wine only on the Saturday in the Holy Week, and meat on the Easter Sunday. Besides the great Lent, they have four others of eight days each, which are instituted to prepare for the four great festivals

vals of the Nativity, the Afcenfion, the Annunciation, and of St George; in which times they muft not fo much as fpeak of eggs, fifh, oil, or butter.

The Armenians have feven facraments; baptifm, confirmation, penance, the euchariſt, extreme unction, orders and matrimony. In baptifm, the child is plunged three times into the water, and the fame form of words that is ufed with us is repeated every time; the prieft then puts a fmall cord made with filk and cotton on the neck of the infant, and anoints his forehead, chin, ftomach, arm-pits, hands, and feet, making the fign of the crofs on each part. When the child is baptized, he is carried home by the godfather with the found of drums and trumpets. The women do not go to church till forty days after their delivery; and they obferve many Jewifh cuftoms.

At the communion, to which infants of two or three months old are admitted, the priefts give a piece of the confecrated hoft foaked in the confecrated wine. The elements are covered with a great veil, and placed in a cup-board near the altar, on the fide of the gofpels. When the prieft takes the chalice and pattin, he is followed by his deacons and fubdeacons, with flambeaux and plates of copper furnifhed with bells: in this manner, with a cenfer before him, he goes in proceffion round the fanctuary; he then fets them on the altar, pronounces the words of confecration, and turns himfelf to the people, who fall down, kifs the earth, and beat their breafts: then, after taking it himfelf, he diftributes the hoft foaked in wine to the people.

The Armenians feem to place the chief part of their religion in faftings and abftinences: and among the clergy, the higher the degree the lower they muft live; infomuch that it is faid the archbifhops live on nothing but pulfe. They confecrate holy water but once a-year; at which time every one fills a pot and carries it home, which brings in a confiderable revenue to the church.

ARMENICA. See Prunus.

ARMENIAN, fomething belonging to or produced in Armenia: thus we fay, *Armenian bole*, *Armenian ftone*, &c. See Bole and *Armenus Lapis.*

ARMENTIERS, a fmall handfome town of the Netherlands, in the county of Flanders, and diftrict of Ypres. It was taken by Lewis XIV. in 1667, who difmantled it; and it now belongs to the French. It is feated on the river Lis. E. Long. 3. 3. N. Lat. 50. 40.

ARMENUS lapis, *Armenian ftone*, in natural hiftory, a mineral fubftance, which is but improperly called a *ftone*; being no other than an ocherous earth, and properly called *blue ochre*. It is a very valuable fubftance in painting, being a bright and lively blue. It was in fo high efteem as paint among the ancients, that counterfeits were continually attempted to ferve in its place. Theophraftus has recorded it as a thing judged worthy a place in the Egyptian annals, which of their kings had the honour of inventing the factitious kind; and he tells us the genuine native fubftance was a thing of that value, that prefents were made of it to great perfons, and that the Phœnicians paid their tribute in it.—It is a very beautiful earth, of an even and regular texture; and of a fine blue, fometimes deeper, fometimes paler, and frequently mixed with green. It is foft, tender, and light; of an even, but fomewhat dufty, furface; it adheres firmly to the tongue, and is dry, but not harfh to the touch. It eafily breaks between the fingers, and does not ftain the hands. It is of a brackifh difagreeable tafte, and does not ferment with acids. It is a very fcarce foffil; but is found very pure, though in but fmall quantities, in the mines at Goffelaer in Saxony. It is frequently found fpotted with green, and fometimes with black; and very often is mixed among the green ochre, called *berggruen* by the Germans, which has thence been erroneoufly called by its name. See further the article Bice.

AMIERS, a town of Hainhault, in the French Netherlands, feated on the river Samber. E. Long. 3. 45. N. Lat. 50. 15.

ARMIGER, a title of dignity, belonging to fuch gentlemen as bear arms: and thefe are either by curtefy, as fons of noblemen, eldeft fons of knights, &c.; or by creation, fuch as the king's fervants, &c. See Esquire.

ARMILLARY, in a general fenfe, fomething confifting of rings or circles.

Armillary Sphere, an artificial fphere compofed of a number of circles of the mundane fphere, put together in their natural order, to eafe and affift the imagination in conceiving the conftitution of the heavens, and the motions of the celeftial bodies. The armillary fphere revolves upon its axis within a filvered horizon, which is divided into degrees, and moveable every way upon a brafs fupporter. The other parts are the equinoctial, zodiac, meridian, the two tropics, and the two poplar circles. See Geography.

ARMILUSTRIUM, in Roman antiquity, a feaft held among the Romans, in which they facrificed, armed to the found of trumpets.

ARMINIANS, a religious fect, or party, which arofe in Holland, by a feparation from the Calvinifts. They followed the doctrine of Arminus (fee the next article); who, thinking the doctrine of Calvin, with regard to free-will, predeftination, and grace, too fevere, began to exprefs his doubts concerning them in the year 1591; and upon further inquiry adopted fentiments more nearly refembling thofe of the Lutherans than of the Calvinifts. After his appointment to the theological chair at Leyden, he thought it his duty to avow and vindicate the principles which he had embraced; and the freedom with which he publifhed and defended them expofed him to the refentment of thofe that adhered to the theological fyftem of Geneva, which then prevailed in Holland; but his principal opponent was Gomar, his colleague. The controverfy which was thus begun, became more general after the death of Arminius, in the year 1609, and threatened to involve the United Provinces in civil difcord. The Arminian tenets gained ground under the mild and favourable treatment of the magiftrates of Holland, and were adopted by feveral perfons of merit and diftinction. The Calvinifts, or Gomarifts, as they were now called, appealed to a national fynod: accordingly the fynod of Dort was convened by order of the States General, in 1618, and was compofed of ecclefiaftical deputies from the United Provinces, as well as from the reformed churches of England, Heffia, Bremen, Switzerland, and the Palatinate. The principal advocate in favour of the Arminians was Epifcopius, who at that time was profeffor of divinity at Leyden. It was firft pro-

Arminians posed to discuss the principal subjects in dispute, and that the Arminians should be allowed to state and vindicate the grounds on which their opinions were founded: but some difference arising as to the proper mode of conducting the debate, the Arminians were excluded from the assembly; their case was tried in their absence; and they were pronounced guilty of pestilential errors, and condemned as corrupters of the true religion. In consequence of this decision, they were treated with great severity; they were deprived of all their posts and employments; their ministers were silenced, and their congregations were suppressed. However, after the death of prince Maurice, who had been a violent partizan in favour of the Gomarists, in the year 1625, the Arminian exiles were restored to their former reputation and tranquillity; and under the toleration of the state, they erected churches and founded a college at Amsterdam, appointing Episcopius to be the first theological professor. The Arminian system has very much prevailed in England since the time of archbishop Laud, and its votaries in other countries are very numerous.

The distinguishing tenets of the Arminians may be comprised in the following five articles; relating to predestination, universal redemption, the corruption of man, conversion, and perseverance.

1. With respect to the first, they maintained, "That God, from all eternity, determined to bestow salvation on those who he foresaw would persevere unto the end in their faith in Christ Jesus; and to inflict everlasting punishments on those who should continue in their unbelief; and resist unto the end his divine succours: so that election was conditional, and reprobation in like manner the result of foreseen infidelity and persevering wickedness."

2. On the second point, the Arminians taught, "That Jesus Christ by his sufferings and death, made an atonement for the sins of all mankind in general, and of every individual in particular; that, however, none but those who believe in him can be partakers of their divine benefit."

3. On the third article, they held, "That true faith cannot proceed from the exercise of our natural faculties and powers, nor from the force and operation of free will; since man, in consequence of his natural corruption, is incapable either of thinking or doing any good thing; and that therefore it is necessary, in order to his conversion and salvation, that he be regenerated and renewed by the operation of the Holy Ghost, which is the gift of God through Jesus Christ."

4. "That this divine grace, or energy of the Holy Ghost, begins and perfects every thing that can be called good in man, and consequently all good works are to be attributed to God alone; that, nevertheless, this grace is offered to all, and does not force men to act against their inclination, but may be resisted and rendered ineffectual by the perverse will of the impenitent sinner." Some modern Arminians interpret this and the last article with a greater latitude.

5. "That God gives to the truly faithful, who are regenerated by his grace, the means of preserving themselves in this state;" and though the first Arminians made some doubt with respect to the closing part of this article, their followers uniformly maintain, "that the regenerate may lose true justifying faith, forfeit their state of grace, and die in their sins."

The modern system of Arminianism likewise, founded on a comprehensive plan projected by Arminius himself, as appears from a passage in his last will, extends the limits of the Christian Church, and relaxes the bonds of fraternal communion in such a manner, that Christians of all sects and denominations, whatever their sentiments and opinions may be, papists excepted, may be formed into one religious body, and live together in brotherly love and concord. But, in order to avoid the reproach of being altogether unconnected by any common principles, Episcopius drew up a confession of faith, expressed for the most part in words and phrases of Holy Scripture, which the Arminians have generally adopted, though not enjoined upon them by any authoritative obligation. The Arminians are also called *Remonstrants*, from an humble petition intitled their *Remonstrance*, which, in the year 1610, they addressed to the States of Holland. Their principal writers are, Arminius, Episcopius, Vorstius, Grotius, Curcellæus, Limborch, Le Clerc, and Wetstein, not to mention many others of more modern date.

Arminius. ARMINIUS (James), whose real name in Low Dutch was James Harmanni, a famous protestant divine, from whom the modern sect of Arminians (see the preceding article) take their name, was born at Oude-water, in Holland, in 1560. He was ordained minister at Amsterdam on the 11th of August 1588; when he soon distinguished himself by his sermons, which were remarkable for their solidity and learning, and gained him universal applause: but Martin Lydias, professor of divinity at Franker, judging him a fit person to refute a writing in which Beza's doctrine of predestination had been attacked by some ministers of Delft, Arminius at his intreaties undertook the task; but upon thoroughly examining the reasons on both sides, he came into the opinions he proposed to destroy, and afterwards went still farther than the ministers of Delft had done. In 1600, he opposed those who maintained that ministers should subscribe the confession and catechism every year. In 1602, a pestilential disease raged at Amsterdam, during which he acted with the greatest resolution and courage, in assisting the poor, and comforting the sick; and Lucas Treclatius and Francis Junius dying of that disease at Leyden, the curators of that university chose Arminius professor of divinity there, and he was afterwards made doctor of divinity. Disputes upon grace were soon after kindled in that university; and he was at length engaged in a new contest, occasioned by a disputation of his concerning the divinity of the Son. These contests, his continual labour, and the concern of seeing his reputation blasted by a multitude of slanders in relation to his opinions, impaired his health, and threw him into a fit of sickness, of which he died on the 19th of October 1609. Arminius was esteemed an excellent preacher: his voice was low, but very agreeable; and his pronunciation admirable: he was easy and affable to persons of all ranks, and facetious in his conversation amongst his friends. His great desire was, that Christians would bear with one another in all controversies which did not affect the fundamentals of their religion; and when they persecuted each other for points of indifference, it gave him the utmost diſſatisfaction. The curators of the univerſity of Leyden had ſo great a regard for him, that they ſettled a penſion upon his wife and children. He left ſeveral works, viz. 1. "Diſputationes de diverſis Chriſtianæ religionis capitibus. 2. Orationes itemque tractatus inſigniores aliquot. 3. Examen modeſti libelli Gulielmi Perkinſii de predeſtinationis modo et ordine, itemque de amplitudine gratiæ divinæ. 4. Analyſis capitis noni ad Romanos. 5. Diſſertatio de vero et genuino ſenſu capitis ſeptimi epiſtolæ ad Romanos. 6. Amica collatio cum D. Franciſco Junio de prædeſtinatione per literas habita. 7. Epiſtola ad Hippolytum a collibus."

ARMIRO, a town of Macedonia, in European Turky, ſeated on the Gulph de Velo. E. Long. 23. 40. N. Lat. 38. 34.

ARMISTICE, in military affairs, a temporary truce or ceſſation of arms for a very ſhort ſpace of time. The word is Latin, *armiſtitium;* and compounded of *arma,* "arms," and *ſto*", to ſtand, or ſtop."

ARMOISIN, a ſilk ſtuff, or kind of taffety, manufactured in the Eaſt-Indies, at Lyons in France, and at Lucca in Italy. That of the Indies is ſlighter than thoſe made in Europe.

ARMONIAC. See AMMONIAC.

ARMONICA. See HARMONICA.

ARMORIAL, ſomething relating to arms, or coats of arms. See ARMS and HERALDRY.

ARMORIC, or AREMORIC, ſomething that belongs to the province of Bretagne, or Britanny, in France. The name *Armorica* was antiently given to all the northern and weſtern coaſt of Gaul, from the Pyreneans to the Rhine; under which name it was known even in Cæſar's time. The word is of Bas Breton origin, and denotes as much as *maritime*; compounded, according to M. Menage, of *ar,* "upon," and *more,* "ſea."

ARMORIST, a perſon ſkilled in the knowledge of armory.

ARMORUM CONCUSSIO, the claſhing of armour practiſed by the Roman armies previous to an engagement, and intended to ſtrike a panic into their enemies: It always followed the Claſſicum and the Barritus. See CLASSICUM and BARRITUS.

ARMOUR, a defenſive habit, wherewith to cover and ſecure the body from the attacks of an enemy. In ancient ſtatutes this is frequently called *harneſs*.—Parts of armour are, the buckler, cuiraſs, helmet, coat of mail, gantlet, &c.

A complete armour anciently conſiſted of a caſque or helm, a gorget, cuiraſs, gantlets, taſſes, braſſets, cuiſhes, and covers for the legs, to which the ſpurs were faſtened. This they called *armour cape-a-pie*; and was the wear of the cavaliers and men at arms.—The infantry had only part of it; viz. a pot or head-piece, a cuiraſs, and taſſes; but all light. Laſtly, the horſes themſelves had their armour, wherewith to cover the head and neck.—Of all this furniture of war, ſcarce any thing is now retained except the cuiraſs; the gorget or neck piece, worn by officers, being at preſent only a badge of honour, and of no defence.

The gallantry of going to the battle naked, without any defenſive armour, prevailed ſo far, that the French, during the reign of Lewis XIV. were obliged to be continually iſſuing ordinances to reſtrain it; in conſequence of which the general officers, and thoſe of the cavalry, were obliged to reſume the cuiraſs, which yet has been but ill obſerved.

ARMOUR, Coat, is the eſcutcheon of any perſon, or family, with its ſeveral charges, and other furniture; as mantling, creſt, ſupporters, motto, &c.—Thus we ſay, a gentleman of coat-armour; meaning one who bears arms.

ARMOURER, a maker of arms, or armour.—The Roman armourers were diſpoſed in certain places in the empire, it being forbid either to ſell, or buy, or make arms elſewhere. They were exempt from all offices and taxes, and received a ſalary from the public.

When once they had taken the employment on themſelves, neither they, nor their children, were allowed to quit it. To prevent this, they had a kind of note, or ſtigma, impreſſed on the arm, whereby they might be known. If any of them fled, or ſecreted their ware, the reſt were obliged to anſwer for him; on account of which, the effects of ſuch as died without a legal heir went to the college.—There were 15 armamentaries, or repoſitories of arms, in the Eaſtern empire, placed near the frontiers, and 19 in the Weſtern.

ARMOURER of a ſhip, a perſon whoſe office is to take care that the arms be in a condition fit for ſervice.

ARMOURY, a ſtore-houſe of arms, or a place wherein military habiliments are kept, to be ready for uſe. There are armouries in the Tower of London, and in all arſenals, citadels, caſtles, &c.

ARMOURY is alſo uſed for a branch of heraldry; being the knowledge of coat-armours, as to their blazons, and various intendments.

ARMOZA, or HARMOZIA, a town in Carmania, at the mouth of the Anamis, which falls into the Perſian gulph, (Arrian); *Armuza,* (Ptolemy); and from this the neighbouring iſland, and a ſmall kingdom, take the modern name of *Ormus.* E. Long. 56. 17. N. Lat. 27. 20.

ARMS, ARMA, in a general ſenſe, includes all kinds of weapons, whether for defence or offence. Nicod derives the word from the Latin phraſe *quod operiant armos,* becauſe they cover the ſhoulders or ſides; but Varro derives *arma, ab arcendo, eo quod arceant hoſtes.* It is ſuppoſed that the firſt artificial arms were of wood, and were only employed againſt beaſts; and that Belus, the ſon of Nimrod, was the firſt that waged war: whence, according to ſome came the appellation *bellum.* Diodorus Siculus takes Belus to be the ſame with Mars, who firſt trained ſoldiers up to battle.—Arms of ſtone, and even of braſs, appear to have been uſed before they came to iron and ſteel. Joſephus aſſures us, that the patriarch Joſeph firſt taught the uſe of iron arms in Egypt, arming the troops of Pharoah with a caſque and buckler.

What contributed moſt to render the Romans maſters of the world, was, that having ſucceſſively warred againſt all nations, they conſtantly renounced their own methods, arms, &c. whenever they met with better. Thus Romulus during his war with the Sabins, a bold and warlike nation, adopted their broad buckler in lieu of the ſmall Argian buckler, which he had uſed till that time.

The principal arms of the ancient Britons were hatchets, ſcythes, lances, ſwords, and bucklers: the Saxons, &c. brought in the halbard, bow, arrows, arbalets, &c. By the ancient laws of England, every man was obliged to bear arms, except the judges and clergy. Under Henry VIII. it was expressly enjoined on all persons to be regularly instructed, even from their their tender years, in the exercise of the arms then in use: viz. the long bow and arrows; and to be provided with a certain number of them. 33 H. VIII.

Arms, *Arma*, in law, are extended to any thing which a man takes in his hand in his wrath, to cast at, or strike another

By the common law, it is an offence for persons to go or ride armed with dangerous weapons: but gentlemen may wear common armour, according to their quality, &c. 3d Inst. The king may prohibit force of arms, and punish offenders according to law; and herein every subject is bound to be aiding. Stat. 7. Edw. I. None shall come with force and arms before the king's justices, nor ride armed in affray of the peace, on pain to forfeit their armour, and to suffer imprisonment, &c. 2 Ed. III. c. 3.

The importation of arms and ammunition are prohibited by 1 Jac. II. c. 8. and by 1 W. and M. stat. 2. c. 2. Protestant subjects may have arms for their defence. So likewise arms, &c. shipped after prohibition, are forfeited by 29 Geo. I. c. 16. sec. 2.

Arms of offence in use among us at present are, the sword, pistol, musket, bayonet, pike, &c.

The arms of the Highlanders are, the broad sword, target, poignard, and whinyar or durk, &c. There are several acts of parliament for disarming the Highlanders; see 1 Geo. I. c. 54.; 11 Geo. I. c. 26.; 19 Geo. II. c. 39.; 21 Geo. II. c. 34.; 26 Geo. II. c. 22. and 29.

Fire-Arms are those charged with powder and ball: such are cannon, mortars, and other ordnance; muskets, carabines, pistols, and even bombs, granadoes, carcasses, &c. In the history of the Royal Academy for the year 1707, we have an account of some experiments made with fire-arms differently loaded by M. Cassini. Among other things he observes, that by loading the piece with a ball which is somewhat less than the calibre, and only laying a little gunpowder below the ball and a good deal above it, it will yield a vehement noise, but have no sensible effect or impulse on the ball. This he takes to have been all the secret of those people who pretended to sell the art of rendering one's self invulnerable or shot-proof.

Arms, pass of, was a kind of combat in use among the ancient cavaliers.

Arms, stand of. A stand of arms signifies a musket, a bayonet, a sword, belt, and cartridge-box.

Arms of parade, or *courtesy*, were those used in the ancient justs and tournaments; which were commonly unshod lances, swords without edge or point, wooden swords, and even canes.

Arms denote the natural weapons, or parts of defence, of beasts: as claws, teeth, tusks of elephants, beaks of birds, &c.

Arms are also used figuratively for the profession of a soldier. Thus we say, he was bred to arms.

Arms, or *Armories*, are also used in heraldry for marks of dignity and honour, regularly composed of certain figures and colours, given or authorised by sovereigns, and borne in banners, shields, coats, &c. for the distinction of persons, families, and states; and passing by descent to posterity. They are called *arms*, in regard they are borne principally on the buckler, cuirass, banners, and other apparatus of war. They are also called *coats of arms*, *coat armour*, &c. because anciently embroidered on sur-coats, &c. See Heraldry. Some will have the name to have been first occasioned by the ancient knights, who in their justs and tournaments bore certain marks (which were frequently their mistress's favours) in their armour, i. e. their helms or shield, to distinguish them from each other.

Arms, at present, follow the nature of titles, which being made hereditary, these are also become so, being the several marks for distinguishing of families and kindreds, as names are of persons and individuals.

Arms are variously distinguished by the *Heralds*.

Arms of alliance, are those which families or private persons join to their own, to denote the alliances which they have contracted by marriage.

Arms, assumptive, are such as a man has a right to assume of himself, in virtue of some gallant action.

As, if a man who is no gentleman of blood, nor has coat armour, takes a gentleman, lord, or prince, prisoner, in any lawful war; he becomes intitled to bear the shield of such prisoner, and enjoy it to him and his heirs. The foundation hereof is that principle in military law, that the dominion of things taken in lawful war passes to the conqueror.

Arms, canting, are those wherein the figures bear an allusion to the name of the family. Such are those of the family of La Tour in Auvergne, who bear a tower; that of the family of Prado in Spain, whose field is a meadow. Most authors hold these the most noble and regular, and is shown by an infinity of instances produced by Father Varenne and Menetrier. They are much debased, when they come to partake of the *Rebus*.

Arms, charged, are such as retain their ancient integrity and value, with the addition of some new honourable charge or bearing, in consideration of some noble action.

Arms of community, are those of bishoprics, cities, universities, and other bodies corporate.

Arms of concession, or augmentation of honour, are either entire arms, or else one or more figures given by princes, as a reward for some extraordinary service.

Arms of dominion, are those which emperors, kings, and sovereign states bear; being annexed to the territories which they possess. Thus the three lions are the arms of England; the fleurs de lys those of France, &c.

Arms of family, or *paternal arms*, are such as belong to a particular family, and which no other person has a right to assume.

Arms, full, or *entire*, are such as retain their primitive purity, integrity, or value; without any alterations, diminutions, abatements, or the like. It is a rule, that the simpler and less diversified the arms, the more noble and ancient they are. For this reason Garcias Ximenes, first king of Navarre, and his successors for several ages, bore only gules, without any figure at all.

The arms of princes of the blood, of all younger sons, and junior families, are not pure and full; but distinguished and diminished by proper differences, &c.

Arms of patronage, are those which governors of provinces, lords of manors, &c. add to their family arms, in token of their peculiar superiority and jurisdiction.

Arms of pretension, are those of such kingdoms or territories to which a prince or lord has some claim, and which he adds to his own, though the kingdoms or territories be possessed by a foreign prince or other lord. Thus the kings of England have quartered the arms of France with their own, ever since the claim of Edward III. to that kingdom, in 1330.

Arms of succession, are assumed by those who inherit estates, manors, &c. by will, entail, or donation, and which they either impale or quarter with their own arms.

Arms are also said to be *parted, couped, quartered*, &c.

Arms are said to be *false* and *irregular*, when there is something in them contrary to the established rules of heraldry. As, when metal is put on metal, or colour on colour, &c.

The laws and other affairs of arms, with the cognizance of offences committed therein, belong to the marshals and colleges of arms.

Arms in falconry, denote the legs of an hawk, from the thigh to the foot. See Falconry.

ARMSTRONG (Dr John), an eminent physician, poet, and miscellaneous writer, was born in Castleton parish, Roxburghshire, where his father and brother were ministers; completed his education in the university of Edinburgh, where he took his degree in physic. Feb. 4, 1732, with much reputation; and published his thesis, as the forms of that university require; the subject was, *De tabe purulenta*. In 1735 he published a little humourous fugitive pamphlet in 8vo, entitled, "An Essay for abridging the study of Physic; to which is added a Dialogue betwixt Hygeia, Mercury, and Pluto, relating to the Practice of Physic, as it is managed by a certain illustrious Society. As also an Epistle from Usbek the Persian to Joshua Ward, Esq." This piece contains much fun and drollery: in the dialogue he has caught the very spirit of Lucian. In 1737 he published A Synopsis of the History and Cure of the Venereal Diseases, 8vo. This was soon followed by the *Oeconomy of Love*; a poem which has much merit: but it must be confessed it is too strongly tinctured with the licentiousness of Ovid. It is said, however, that his maturer judgment expunged many of the luxuriances of youthful fancy, in an edition "revised and corrected by the author" in 1768. It appears by one of the cases on literary property, that Mr Millar paid 50 guineas for the copyright of this poem, which was intended as a burlesque on some dictatic writers. It has been observed of Dr Armstrong, that his works have great inequalities, some of them being possessed of every requisite to be sought after in the most perfect composition, while others can hardly be considered as superior to the productions of mediocrity. *The Art of preserving Health*, his best performance, which was published in 1744, will transmit his name to posterity as one of the first English writers, has been honoured with the following testimony of a respectable critic. On this work we shall also transcribe a beautiful elogium from an eminent physician †: "Of all the poetical performances on this subject that have come to my hands. Dr Armstrong's Art of preserving health is by far the best. To quote every charming description and beautiful passage of this poem, one must transcribe the whole. We cannot, however, expect new rules, where the principal design was to raise and warm the heart into a compliance with the solid precepts of the ancients, which he has enforced with great strength and elegance. And upon the whole, he has convinced us by his own example, that we ought not to blame antiquity for acknowledging

One power of physic, melody, and song."

† *Dr Mackenzie's History of Health.*

In 1746 Dr Armstrong was appointed one of the physicians to the hospital for lame and sick soldiers behind Buckingham house. In 1751 he published his poem on Benevolence, in folio; and in 1753, "Taste, an epistle to a young Critic." In 1758 appeared, "Sketches, or Essays on various subjects, by Launcelot Temple, Esq; in two parts." In this production, which possesses much humour and knowledge of the world, and which had a remarkably rapid sale, he is supposed to have been assisted by Mr Wilkes. In 1760 he had the honour of being appointed physician to the army in Germany, where in 1761 he wrote a poem called "Day, an Epistle to John Wilkes of Aylesbury, Esq;" In this poem, which is not collected in his works, he wantonly hazarded a reflection on Churchill, which drew on him the serpent-toothed vengeance of that severest of satirists, whose embalming or corrosive pen could deify or lampoon any man, according as he acquiesced with, or dissented, from his political principles. In 1770 Dr Armstrong published a collection of "Miscellanies in 2 vols.; containing, 1. The Art of preserving Health. 2. Of Benevolence, an Epistle to Eumenes. 3. Taste, an Epistle to a youg critic, 1753. 4. Imitations of Shakespeare and Spencer. 5. The Universal Almanac, by Noureddin Ali. 6. The Forced Marriage, a tragedy. 7. Sketches." In 1771 he published "A short ramble through some parts of France and Italy, by Launcelot Temple: and in 1773, in his own name, a quarto pamphlet, under the title of *Medical Essays*; towards the conclusion of which, he accounts for his not having such extensive practice as some of his brethren, from his not being qualified to employ the usual means, from a ticklish state of spirits, and a distempered excess of sensibility. He complains much of the behaviour of some of his brethren, of the herd of critics, and particularly of the reviewers. He died in Sept. 1779; and to the no small surprise of his friends, left behind him more than L.300 saved out of a very moderate income, arising principally from his half-pay.

ARMUYDEN, a sea-port town of the United provinces, in the island of Walcherin, formerly very flourishing; but now inconsiderable, the sea having stopped up the harbour. The salt-works are its chief resource. E. Long. 3. 40. N. Lat. 51 30.

ARMY, a large number of soldiers, consisting of horse and foot, completely armed, and provided with artillery, ammunition, provisions, &c. under the command of one general, having lieutenant-generals, major-generals, brigadiers, and other officers, under him. An army is composed of squadrons and battalions; and is usually divided into three corps, and formed into three lines: the first line is called the *van-guard*, the second the *main-body*, and the third the *rear-guard* or

body

 body of reserve. The middle of each line is possessed by the foot; the cavalry form the right and left wing of each line; and sometimes they place squadrons of horse in the intervals between the battalions. When the army is drawn up in order of battle, the horse are placed at five feet distance from each other, and the foot at three. In each line the battalions are distant from each other 180 feet, which is nearly equal to the extent of their front; and the same holds of the squadrons, which are about 300 feet distant, the extent of their own front. These intervals are left for the squadrons and battalions of the second line to range themselves against the intervals of the first, that both may more readily march through these spaces to the enemy: the first line is usually 300 feet distant from the second, and the second from the third, that there may be sufficient room to rally when the squadrons and battalions are broken. See the article WAR.

This is to be understood of a land-army only. A naval or sea-army is a number of ships of war, equipped and manned with sailors and mariners, under the command of an admiral, with other inferior officers under him. See *Naval TACTICS*.

It has been observed, that in Europe a prince with a million of subjects cannot keep an army of above 10,000 men, without ruining himself. It was otherwise in the ancient republics: the proportion of soldiers to the rest of the people, which is now as about 1 to 100, might then be as about 1 to 8. The reason seems owing to that equal portion of lands which the ancient founders of commonwealths made among their subjects; so that every man had a considerable property to defend, and means to defend it with: whereas, now, the lands and riches of a nation being shared among a few, the rest have no way of subsisting but by trade, arts, and the like: and have neither any free property to defend, nor means to enable them to go to war in defence of it, without starving their families. A large part of our people are either artisans or servants, and so only minister to the luxury and effeminncy of the great. While the equality of lands subsisted, Rome, though only a little state, being refused the succours which the Latins were obliged to furnish after the taking of the city in the consolate of Camillus, presently raised ten legions within its own walls; which was more, Livy assures us, than they were able to do in his time, tho' masters of the greatest part of the world. A full proof, adds the historian, that we are not grown stronger; and that what swells our city is only luxury, and the means and effects of it.

Armies anciently were a sort of militia, composed chiefly of the vassals and tenants of the lords. When each company had served the number of days or months enjoined by their tenure, or the customs of the fees they held, they returned home. The armies of the empire consisted of divers bodies of troops furnished by the several circles. The gross of the French armies, under the Merovingian race, consisted of infantry. Under Pepin and Charlemagne, the armies consisted almost equally of cavalry and foot: but since the declension of the Carlovingian line, the fees being become hereditary, the national armies, says Le Gendre, are chiefly cavalry.

A well-regulated standing army is greatly superior to a militia; although a militia, it is to be observed, after serving two or three campaigns, may become equal to a standing army, and in every respect a match for veteran troops. See MILITIA.

One of the first standing armies of which we have any distinct account, in any well authenticated history, is that of Philip of Macedon. His frequent wars with the Thracians, Illyrians, Thessalians, and some of the Greek cities in the neighbourhood of Macedon, gradually formed his troops, which in the beginning were probably militia, to the exact discipline of a standing army. When he was at peace, which he was very seldom, and never for any long time together, he was careful not to disband that army. It vanquished and subdued, after a long and violent struggle, indeed, the gallant and well exercised militias of the principal republics of ancient Greece; and afterwards, with very little struggle, the effeminate and ill-exercised militia of the great Persian empire. The fall of the Greek republics and of the Persian empire, was the effect of the irresistible superiority which a standing army has over every sort of militia. It is the first great revolution in the affairs of mankind of which history has preserved any distinct or circumstantial account.

The fall of Carthage, and the consequent elevation of Rome, is the second. All the varieties in the fortune of those two famous republics may very well be accounted for from the same cause.

From the end of the first to the beginning of the second Carthaginian war, the armies of Carthage were continually in the field, and employed under three great generals, who succeeded one another in the command; Amilcar, his son-in-law Asdrubal, and his son Annibal; first in chastising their own rebellious slaves, afterwards in subduing the revolted nations of Africa, and, lastly, in conquering the great kingdom of Spain. The army which Annibal led from Spain into Italy must necessarily, in those different wars, have been gradually formed to the exact discipline of a standing army. The Romans, in the mean time, tho' they had not been altogether at peace, yet they had not, during this period, been engaged in any war of very great consequence; and their military discipline, it is generally said, was a good deal relaxed. The Roman armies which Annibal encountered at Trebia, Thrasymenus, and Cannæ, were militia opposed to a standing army. This circumstance, it is probable, contributed more than any other to determine the fate of those battles.

The standing army which Annibal left behind him in Spain, had the like superiority over the militia which the Romans sent to oppose it, and in a few years under the command of his brother the younger Asdrubal, expelled them almost entirely from that country.

Annibal was ill supplied from home. The Roman militia, being continually in the field, became in the progress of the war a well-disciplined and well-exercised standing army; and the superiority of Annibal grew every day less and less. Asdrubal judged it necessary to lead the whole, or almost the whole, of the standing army which he commanded in Spain, to the assistance of his brother in Italy. In this march he is said to have been misled by his guides; and in a country which

which he did not know, was surprised and attacked by another standing army, in every respect equal or superior to his own, and was entirely defeated.

When Asdrubal had left Spain, the great Scipio found nothing to oppose him but a militia inferior to his own. He conquered and subdued that militia; and in the course of the war, his own militia necessarily became a well-disciplined and well-exercised standing army. That standing army was afterwards carried to Africa, where it found nothing but a militia to oppose it. In order to defend Carthage it became necessary to recall the standing army of Annibal. The disheartened and frequently defeated African militia joined it, and at the battle of Zama composed the greater part of the troops of Annibal. The event of that day determined the fate of the two rival republics.

From the end of the second Carthagenian war till the fall of the Roman republic, the armies of Rome were in every respect standing armies. The standing army of Macedon made some resistance to their arms. In the height of their grandeur, it cost them two great wars, and three great battles, to subdue that little kingdom; of which the conquest would probably have been still more difficult, had it not been for the cowardice of its last king. The militias of all the civilized nations of the ancient world, of Greece, of Syria, and of Egypt, made but a feeble resistence to the standing armies of Rome. The militias of some barbarous nations defended themselves much better. The Scythian or Tartar militia, which Mithridates drew from the countries north of the Euxine and Caspian seas, were the most formidable enemies whom the Romans had to encounter after the second Carthaginian war. The Parthian and German militias too were always respectable, and upon several occasions gained very considerable advantages over the Roman armies. In general, however, and when the Roman armies were well commanded, they appear to have been very much superior.

Many different causes contributed to relax the discipline of the Roman armies. Its extreme severity was, perhaps, one of those causes. In the days of their grandeur, when no enemy appeared capable of opposing them, their heavy armour was laid aside as unnecessarily burthensome, their laborious exercises were neglected as unnecessarily toilsome. Under the Roman emperors besides, the standing armies of Rome, those particularly which guarded the German and Pannonian frontiers, became dangerous to their masters, against whom they used frequently to set up their own generals. In order to render them less formidable, according to some authors, Dioclesian, according to others Constantine, first withdrew them from the frontier, where they had always before been encamped in great bodies, generally of two or three legions each, and dispersed them in small bodies through the different provincial towns, from whence they were scarce ever removed, but when it became necessary to repel an invasion. Small bodies of soldiers quartered in trading and manufacturing towns, and seldom removed from those quarters, became themselves tradesmen, artificers, and manufacturers. The civil came to predominate over the military character; and the standing armies of Rome gradually degenerated into a corrupt, neglected, and undisciplined militia, incapable of resisting the attack of the German and Scythian militias, which soon afterwards invaded the western empire. It was only by hiring the militia of some of those nations to oppose to that of others, that the emperors were for some time able to defend themselves. The fall of the western empire is the third great revolution in the affairs of mankind, of which ancient history has preserved any distinct or circumstantial account. It was brought about by the irresistible superiority which the militia of a barbarous has over that of a civilized nation; which the militia of a nation of shepherds has over that of a nation of husbandmen, artificers, and manufactures. The victories which have been gained by militias have generally been not over standing armies, but over other militias in exercise and discipline inferior to themselves. Such were the victories which the Greek militia gained over that of the Persian empire; and such too were those which in later times the Swiss militia gained over that of the Austrians and Burgundians.

The military force of the German and Scythian nations, who established themselves upon the ruins of the western empire, continued for some time to be of the same kind in their new settlements as it had been in their original country. It was a militia of shepherds and husbandmen, which in time of war took the field under the cammand of the same chieftans whom it was accustomed to obey in peace. It was therefore tolerably well exercised and tolerably well disciplined. As arts and industry advanced, however, the authority of the chieftans gradually decayed, and the great body of the people had less time to spare for military exercises. Both the discipline and the exercise of the feudal militia, therefore, went gradually to ruin, and standing armies were gradually introduced to supply the place of it. When the expedient of a standing army, besides, had once been adopted by one civilized nation, it became necessary that all its neighbours should follow the example. They soon found that their safety depended upon their doing so, and that their own militia was altogether incapable of resisting the attack of such an army.

The soldiers of a standing army, though they may never have seen an enemy, yet have frequently appeared to possess all the courage of veteran troops, and the very moment that they took the field, to have been fit to face the hardiest and most experienced veterans. In a long peace the generals perhaps may sometimes forget their skill; but where a well-regulated standing army has been kept up, the soldiers seem never to forget their valour.

When a civilized nation depends for its defence upon a militia, it is at all times exposed to be conquered by any barbarous nation which happens to be in its neighbourhood. The frequent conquests of all the civilized countries in Asia by the Tartars, sufficiently demonstrates the natural superiority which the militia of a barbarous has over that of a civilized nation. A well-regulated standing army is superior to every militia. Such an army, as it can be best maintained by an opulent and civilized nation, so it can alone defend such a nation against the invasion of a poor and barbarous neighbour. It is only by means of a standing army, therefore, that the civilization of any country can be perpetuated, or even preserved for any considerable time.

As

Army, Arnall.

As it is only by means of a well-regulated standing army that a civilized country can be defended, so it is only by means of it that a barbarous country can be suddenly and tolerably civilized. A standing army establishes, with an irresistible force, the law of the sovereign through the remotest provinces of the empire, and maintains some degree of regular government in countries which could not otherwise admit of any. Whoever examines with attention the improvements which Peter the Great introduced into the Russian empire, will find that they almost all resolve themselves into the establishment of a well-regulated standing army. It is the instrument which executes and maintains all his other regulations. That degree of order and internal peace which that empire has ever since enjoyed, is altogether owing to the influence of that army.

Men of republican principles have been jealous of a standing army as dangerous to liberty. It certainly is so, wherever the interest of the general and that of the principal officers are not necessarily connected with the support of the constitution of the state. The standing army of Cæsar destroyed the Roman republic; the standing army of Cromwell turned the long parliament out of doors. But where the sovereign is himself the general, and the principal nobility and gentry of the country the chief officers of the army; where the military force is placed under the command of those who have the greatest interest in the support of the civil authority, because they have themselves the greatest share of that authority; a standing army can never be dangerous to liberty: on the contrary, it may in some cases be favourable to liberty. The security which it gives to the sovereign renders unnecessary that troublesome jealousy which in some modern republics seems to watch over the minutest actions, and to be at all times ready to disturb the peace of every citizen. Where the security of the magistrate, though supported by the principal people of the country, is endangered by every popular discontent; where a small tumult is capable of bringing about in a few hours a great revolution; the whole authority of government must be employed to suppress and punish every murmur and complaint against it. To a sovereign, on the contrary, who feels himself supported not only by the natural aristocracy of the country, but by a well-regulated standing army, the rudest, the most groundless, and the most licentious remonstrances, can give little disturbance. He can safely pardon or neglect them, and his consciousness of his own superiority naturally disposes him to do so. That degree of liberty which approaches to licentiousness can be tolerated only in countries where the sovereign is secured by a well-regulated standing army. It is in such countries only that the public safety does not require that the sovereign should be trusted with any discretionary power for suppressing even the impertinent wantonness of this licentious liberty.

ARNALL (William), a noted political writer in defence of Sir Robert Walpole, was originally an attorney's clerk; but being recommended to Walpole, he employed him for a course of years in writing the *Free Briton* and other papers in defence of his administration. By the report of the secret committee, he appears to have received, in the space of four years, no less than L. 10,997 : 6 ; 8 out of the treasury for his writings! but spending his money as fast as it came, and his supplies stopping on Sir Robert's resignation, he died broken-hearted and in debt, in the 26th year of his age. His invention was so quick, that his honourable employer used to say, no man in England could write a pamplet in so little time as Arnall.

Arnaud.

ARNAUD DE MEYRVEILH, or MEREUIL, a poet of Provence, who lived at the beginning of the 13th century. He wrote a book intitled *Las recastenas de sa comtesse*, and a collection of poems and sonnets. He died in the year 1220. Petrarch mentions him in his Triumph of Love.

ARNAUD DE VILLA NOVA, a famous physician, who lived about the end of the 13th and beginning of the 14th century. He studied at Paris and Montpelier, and travelled through Italy and Spain. He was well acquainted with languages, and particularly with the Greek, Hebrew, and Arabic. He was at great pains to gratify his ardent desire after knowledge; but this passion carried him rather too far in his researches: he endeavoured to discover future events by astrology, imagining this science to be infallible; and upon this foundation he published a prediction, that the world would come to an end in the middle of the 14th century. He practised physic at Paris for some time: but having advanced some new doctrines, he drew upon himself the resentment of the university; and his friends, fearing he might be arrested, persuaded him to retire from that city. Upon his leaving France, he retired to Sicily, where he was received by king Frederic of Arragon with the greatest marks of kindness and esteem. Some time afterwards, this prince sent him to France, to attend Pope Clement in an illness; and he was shipwrecked on the coast of Genoa, about the year 1313. The works of Arnaud, with his life prefixed, were printed in one volume in folio, at Lyons, in 1520; and at Basil in 1585, with the notes of Nicholas Tolerus.

ARNAUD D'ANDILLY (Robert), the son of a celebrated advocate of the parliament of Paris, was born in 1588; and, being introduced young at court, was employed in many considerable offices, all which he discharged with great integrity and reputation. In 1644 he quitted business, and retired into the convent of Port Royal des Champs, where he passed the remainder of his days in a continued application to works of piety and devotion; and enriched the French language with many excellent translations of different writers, as well as with religious compositions of his own. He died in 1674, and his works are printed in 8 vols folio.

ARNAUD (Anthony), brother of the preceding, and a doctor of the Sorbonne, was born in 1612. He published, in 1643, *A treatise on frequent communion*, which highly displeased the Jesuits; and the disputes upon grace, which broke out about this time in the university of Paris, and in which he took a zealous part with the Jansenists, helped to increase the animosity between him and the Jesuits. But nothing raised so great a clamour against him as the two letters he wrote on *Absolution*; in the second of which the faculty of divinity found two propositions which they condemned, and M. Arnaud was expelled the society. Upon this he retired; and during a retreat which lasted near 25 years, he composed that great variety of works which are extant of his, on grammar, geometry, logic, metaphysics,

taphysics, and theology. In 1679, he withdrew from France, living in obscurity in the Netherlands, and died in 1694. His heart, at his own request, was sent to be deposited in the Port Royal. Arnaud had a remarkable strength of genius, memory, and command of his pen; nor did these decay even to the last year of his life. Mr Bayle says, he had been told by persons who had been admitted into his familiar conversation, that he was a man very simple in his manners; and that unless any one proposed some question to him, or desired some information, he said nothing that was beyond common conversation, or that might make one take him for a man of great abilities; but when he set himself to give an answer to such as proposed a point of learning, he seemed as it were transformed into another man: he would then deliver a multitude of fine things with great perspicuity and learning, and had a particular talent at making himself intelligible to persons of not the greatest penetration.

ARNAY-LE-DUC, a town of France, in the duchy of Burgundy, which carries on a pretty good trade. It is seated on the Auxois, in a valley near the river Aroux. E. Long. 4. 26. N. Lat. 47. 7.

ARNDT (John), a famous Protestant divine of Germany, born at Ballenstad, in the duchy of Anhalt, in the year 1555. At first he applied himself to the study of physic: but falling into a dangerous sickness, he made a vow to change his profession for that of divinity, if he should be restored to health; which he accordingly did upon his recovery. He was minister first at Quedlinburg and then at Brunswick. He met with great opposition in this last city: his success as a preacher raised the enmity of his brethren, who became his bitter enemies. In order to ruin his character, they ascribed a variety of errors to him; and persecuted him to such a degree, that he was obliged to leave Brunswick, and retire to Isleb, where he was minister for three years. In 1611, George Duke of Lunenburg, who had a high opinion of his integrity and sanctity, gave him the church of Zell, and appointed him superintendant of all the churches in the duchy of Lunenburg; which office he discharged for 11 years, and died in 1621. It is reported that he foretold his death, having said to his wife, upon his return home after his last sermon, that now he had preached his funeral sermon. He wrote in High Dutch *A treatise on true Christianity*, which has been translated into several languages.

ARNE (Dr Thomas Augustine), distinguished by his skill in music, was the son of Mr Arne an upholsterer in Covent Garden, whom Addison is supposed to have characterised in N° 155 and N° 160 of The Tatler; and brother of Mrs Cibber the player. He was early devoted to music, and soon became eminent in his profession. July 6. 1759, he had the degree of doctor of music conferred on him at Oxford. His compositions are universally applauded, and he was also particularly skilful in instructing vocal performers. He died March 5. 1778, having written the following pieces: *Artaxerxes*, 1762; *The Guardian outwitted*, 1764; *The Rose*, 1778; all of them operas.

ARNHEIM, a town of the Low Countries, in the province of Guelderland, capital of Veluive. It is adorned with several fine churches, particularly that of St Walburg and of St Eusebius: which last has a very high tower. The town has five gates, and several fine ramparts, part of which are washed by the Rhine, and the other parts have wide and deep ditches before them. There is a canal made between this place and Nimeguen, at the expence of both towns, on which boats pass backwards and forwards to carry on a trade between them. The air is very healthful; on which account it is inhabited by persons of distinction. E. Long. 5. 55. N. Lat. 52. 0.

ARNICA, LEOPARDS BANE, in botany: A genus of the polygamia superflua order, belonging to the syngenesia class of plants; and in the natural method ranking under the 49th order, *Compositæ discoides*. The receptacle is naked; the pappus is simple; and the filaments are five, without antheræ. The

Species are seven, all natives of Ethiopia, except the two following: 1. The montana, with oval leaves, grows naturally on the Alps, and also upon many of the high mountains in Germany, and other cold parts of Europe. The roots of this species, when planted in a proper soil and situation, spread very far under the surface, and put out many entire oval leaves, from between which the flower-stems arise, which grow about a foot and an half high. The top is terminated by a single yellow flower, composed of many florets, like those of the dandelion. These are succeeded by oblong seeds, which are covered with down. 2. The scorpioides, with sawed leaves growing alternately, is a native of Bohemia and Siberia. The roots of this sort are much jointed, and divide into many irregular fleshy off-sets, which are variously contorted; from whence some superstitious persons have imagined that they would expel the poison of scorpions, and cure the wounds made by the sting of that animal.

Culture. The first species delights in a moist shady situation: it may be propagated by parting the roots in autumn when the stalks begin to decay; or by the seeds sown in autumn soon after they are ripe, for those sown in the spring often fail. The second sort is to be propagated in the same manner. Both are very hardy, and require no other care than to be keept free from weeds.

Medicinal Uses. The montana has an acrid bitter taste, and when bruised, emits a pungent odour, which excites sneezing. On this account the country people in some parts of Germany use it in snuff, and smoke it like tobacco. It was formerly represented as a remedy of great efficacy against effusions and suffusions of blood, from falls, bruises, or the like; and it was then also mentioned as a remedy in jaundice, gout, nephritis, &c. but in these affections it is now very little, if at all, employed.

Of late it has been principally recommended in paralytic affections, and in cases where a loss or diminution of sense arises from an affection of the nerves, as in instances of amaurosis. In these it has chiefly been employed under the form of infusion. From a dram to half an ounce of the flowers has been directed to be infused in a pint of boiling water, and taken in different doses in the course of the day: sometimes it produces vomiting, sometimes sweating, sometimes diuresis; but frequently its use is attended with no sensible operation, unless it can be considered as such, that in some cases

Arnisæus Arnobius.

cases of paralysis, the cure is said to be preceded by a peculiar prickling, and by shooting pains in the affected parts.

Besides being employed in paralytic affections, it has also been of late represented as a very powerful antispasmodic; and it is said to have been successfully employed in fevers, particularly those of the intermittent kind, and likewise in cases of gangrene. In those diseases it has been said to prove as efficacious as the Peruvian bark, when employed under the form of a pretty strong decoction taken in small dozes frequently repeated, or under the form of an electuary with honey.

But as these alleged virtues have not been confirmed by any trials made in Britain, its real influence still remains to be determined by future observations. It is, however, one of those active substances from which something may be expected.

ARNISÆUS (Henningus), a philosopher and physician of great reputation, about the beginning of the 17th century. He was born at Halberstad in Germany, and was professor of physic in the university of Helmstad. His political works are much esteemed. The most remarkable of them is his book *De authoritate principum in populum semper inviolabili*, printed at Francfort, in 1612. In this he maintains that the authority of princes ought not to be violated. He wrote also upon the same doctrine his three books *De jure majestatis*, printed at the same place in 1610; and his *Reflectiones politicæ*, printed at Francfort in 1615. Having received an invitation to go to Denmark, he went thither, and was made counsellor and physician to the King. He travelled into France and England, and died in November 1635. Besides the pieces already mentioned, he wrote several philosophical, medicinal and political treatises.

ARNOBIUS, professor of rhetoric at Sicca, in Numidia, towards the end of the third century. It was owing to certain dreams which he had that he became desirous of embracing Christianity. For this purpose he applied to the bishops to be admitted into the church. But they, remembering the violence with which he had always opposed the true faith, had some distrust him; and, before they would admit him, insisted on some proofs of his sincerity. In compliance with this demand, he wrote against the Gentiles; wherein he has refuted the absurdities of their religion, and ridiculed their false gods. In this treatise he has employed all the flowers of rhetoric, and displayed great learning: but from an impatience to be admitted into the body of the faithful, he is thought to have been in too great a hurry in composing his work, and thence it is that there does not appear in this piece such an exact order and disposition as could be wished; and not having a perfect and exact knowledge of the Christian faith, he published some very dangerous errors. Mr Bayle remarks, that his notions about the origin of the soul, and cause of natural evil, and several other important points, are highly pernicious. St Jerom, in his epistle to Paulinus, is of opinion that his style is unequal and too diffuse, and that his book is written without any method; but Dr Cave thinks this judgment too severe, and that Arnobius wants neither elegance nor order in his composition. Vossius styles him *the Varro of the ecclesiastical writers*. Du Pin observes that his work is written in a manner worthy of a professor of rhetoric: the turn of his sentiments is very oratorical; but his style is a little African, his expressions being harsh and inelegant. We have several editions of this work of Arnobius against the Gentiles, one published at Rome in 1542, at Basil in 1546 and 1560, at Paris in 1570, at Antwerp in 1582, and one at Hamburgh in 1610, with notes by Gebhard Elmenhorstius, besides many others. He wrote also a piece intitled *De rhetoricæ institutione*; but this is not extant.

Arnold.

ARNOLD, of Brescia, in Italy, distinguished himself by being the founder of a sect which opposed the wealth and power of the Romish clergy. He went into France, where he studied under the celebrated Peter Abelard. Upon his return to Italy, he put on the habit of a monk, and opened his invectives in the streets of Brescia. The people crowded round him. He told them he was sent to reform abuses, to pull down the proud and to exalt the humble. He then pointed his declamation against the bishops, against the clergy, against the monks, and finally against the Roman pontiff himself: to the laity only he was indulgent. Churchmen, said he, who hold benefices, bishops who have domains, and monks that have possessions, will all be damned. His hearers shouted approbation. These things, continued he, belong to the prince; he may give them to whom he pleases, but he must give them to the laity. It is on their tithes, and the voluntary contributions of the people, that those sons of God must live: they must be frugal, continent, and mortified.

The church of Brescia was soon thrown into the greatest confusion, and the people, already prejudiced against their ministers threatened to overturn their altars. The sacred writings he urged in support of his assertions, and from thenm he denounced the vengeance of Heaven against the violators of the law. Indeed, nothing could be more glaringly offensive than the ostentatious parade of the bishops and great abbots, and the soft and licentious lives of the monks and clergy.

In 1139 was celebrated a grand council at Rome. Arnold was cited to appear before it. His accusers were the bishop of Brescia, and many others, whom he had ridiculed and insulted. Nor from his judges could he look for much indulgence. He was found guilty, and sentenced to perpetual silence. Upon this he left Italy, crossed the Alps, and found a refuge in Zurich.

Though Arnold had quitted Italy, yet had his opinions taken deep root, and Rome itself was infected by them. Irritated by the conduct of their master Innocent II. the Roman people assembled in the Capitol. It was proposed that the power of the pontiff, which they called exorbitant, should be restrained: this was carried: when suddenly, inspired as it were by the genius of the place, they moved that the senate, which for years had been abolished, should be restored. The proposition was received with the loudest acclamations. Innocent in vain opposed the bold design; there was a magic in it which spread irresistibly, and for a moment seemed to rouse the fallen spirit of the nation. The pope viewed with horror the reverse of fortune which threatened the tiara; to be shorn of his

Arnold

his mighty power, and to become the mere ſhepherd of the Chriſtian people, was a thought too afflicting: he fell ſick and died.

Under his two immediate ſucceſſors Celeſtin and Lucius, whoſe reigns were but of a few months, the Romans purſued their darling object. They waited on the latter, and, in an imperious tone, demanded the reſtitution of all the honours and civil rights which had been uſurped from the people. The prince of the ſenate, ſaid they, whom we have choſen, will beſt adminiſter the important truſt: the tithes and offerings of the faithful will ſufficiently anſwer all the exigencies of your holineſs: it was thus that our ancient biſhops lived.—Lucius ſurvived this event but a few days. His ſucceſſor was Eugenius III. the friend and diſciple of the renowned Bernard. The night before his conſecration the ſenators aſſembled, and it was agreed, that either he ſhould ſolemnly confirm all their proceedings, or they would annul his election. This reſolution was notified to him. He called together his friends; and it was their advice, that he ſhould neither accede to the extravagant demand, nor expoſe himſelf, by a refuſal, to the fury of the populace. He therefore ſilently withdrew from Rome, and retired to a neighbouring fortreſs. Here the ceremony of his conſecration was performed.

Arnold, who in baniſhment had contemplated the effect of his admonitions on the minds of the Romans, and the ſucceſs which ſeemed to follow their exertions, was now informed that the pope had retired, and that the gates of the capital were open to receive him: it was likewiſe ſuggeſted to him, that his preſence was more than ever neceſſary, to give energy to their reſolves, form to their plans, and ſtability to their undertakings. Arnold took fire at the news; an unuſual ſwell of enthuſiaſm filled his breaſt; and he fancied that, like Junius Brutus, he was called at once to give liberty to Rome. At his appearance a new ſtream of vigour animated the citizens; they called him their friend and deliverer. The Breſcian walked amongſt them; his deportment was humble, his countenance emaciated, his addreſs affable, and he ſpoke to them of moderation, of ſubmiſſion, of obedience. With the the nobles and new ſenators he held another language; though to them alſo he was mild and diffident, ſpeaking much of virtue and of reſpect for religion and the laws. But no ſooner was he ſenſible of his own real influence, and ſaw the lengths to which the revolters had already carried their deſigns, than he threw aſide the maſk, and appeared in his own character, daring, impetuous, ſelf-ſufficient, vain. He harangued the people; he talked of their forefathers the ancient Romans, who, by the wiſdom of their ſenate and the valour of their armies, had conquered nations and ſubdued the earth. He dwelt on the names and the atchievements of the Bruti, the Gracchi, and the Scipios; and of theſe men, ſaid he, are you not the children? He adviſed, that the capital be inſtantly repaired; that the equeſtrian order be reſtored; that the people have their tribunes; that dignity attend the ſenate; and that the laws, which had been ſilent and neglected, be revived in all their vigour. He ſpoke of the pope as of a depoſed and baniſhed tyrant: "But ſhould you again be diſpoſed (continued he) to admit him within theſe walls; firſt fix your own rights and determine his. He is but your biſhop: let him therefore have his ſpiritual juriſdiction. The government of Rome, its civil eſtabliſhments, and its territories, belong to you. Theſe you will keep if you have the ſpirit of men and the hearts of Romans." Fired by this harangue, the people, headed by the moſt diſaffected of the nobles, publicly attacked the few cardinals and churchmen who remained in the city; they ſet fire to the palaces; and they compelled the citizens to ſwear obedience to the new government. Moderate men, who ſaw the folly of the attempt, were ſhocked at theſe exceſſes of popular phrenzy; but it was in vain to oppoſe the torrent: they ſubmitted, looking forward, with ſome curioſity, to the termination of an event which had begun in extravagance, and muſt end in diſappointment.

Arnold.

Eugenius till now had viewed with ſome concern, the wild derangement of his people: but when it ſeemed that their eyes opened to their own exceſſes, he could be inactive no longer. He excommunicated the ringleaders of the faction; and at the head of his troops, who were chiefly compoſed of Tiburtini, a people always hoſtile to the Romans, he marched againſt the enemy. His friends within the walls, who were numerous, co-operated with his deſigns, and in a few days overtures for peace were made to the pontiff. He acceded to them, but on condition that they ſhould annul the arrangements they had made, and if they would have ſenators, that they ſhould acknowledge all their power was from him. The people were ſatisfied, and they threw open the gates, through which Eugenius entered, among the acclamations of a fawning and inconſtant multitude.—Before this event, Arnold had retired; but he left behind him many friends ſtrongly attached to his perſon and principles. Of himſelf we hear little more till the reign of Adrian; when, on account of freſh tumults, he and his adherents were excommunicated, and Rome was threatened with an interdict unleſs they expelled the whole party from their walls. This they did. The Arnoldiſts retired with their champion into Tuſcany, where he was received as a prophet and honoured as a ſaint. His enemies, however, prevailed: he was made priſoner, and conducted under a ſtrong eſcort to Rome. In vain was great intereſt made to ſave his life; he was condemned and executed, and his aſhes thrown into the Tiber, leſt the people ſhould collect his remains and venerate them as the relics of a ſainted martyr.

"Such was Arnold of Breſcia; a man (ſays Mr Berington*), whoſe character, whoſe principles, and whoſe views, we perhaps ſhould be diſpoſed to admire, had his life been recorded by unprejudiced hiſtorians, and not brought down to us drawn in the blackeſt colours which party, bigotted zeal, and enthuſiaſm, could lay on. He was raſh, miſjuding, and intemperate, or never would he have engaged in ſo unequal a conteſt.—The view of ſuch a phenomenon in the 12th century excites a pleaſing admiration. To attack the Roman pontiff and his clergy in the very centre of their power, required a more than common ſhare of fortitude; to adopt a ſettled ſcheme of reſtoring to its priſtine glory the republic of Rome, demanded a ſtretch of thought comprehenſive and enterpriſing; and to forego the eaſe and indulgence of a diſſipated age, for the reformation of manners and the ſuppreſ-

* *Hiſt. of the Lives of Abelard and Heloiſa.*

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sion of what he thought usurped dominion, argued a character of mind disinterested, generous, and benevolent. But Arnold, like other reformers, went too far; and passion soon vitiated undertakings which were begun perhaps with motives the most laudable.—The readiness with which the Roman people embraced this plan of lowering the jurisdiction of the pontiff, and restraining it within those bounds which the true spirit of Christianity had fixed, at once shows that they could reason justly, and that they considered the unbounded sway of the triple crown, to which reluctantly they submitted, as an assumed prerogative, to which violence or misconstruction, and not Christian right, had given efficacy."

ARNOLDISTS, in church-history, a sect so called from their leader Arnold of Brescia. See the preceding article.

ARNOLDUS (Gothofredus), pastor and inspector of the churches of Perleberg, and historiographer to the king of Prussia, was born at Annaburg in the mountains of Misnia in 1666. He was a zealous defender of Pietists, a sect among the German Protestants, and composed a great number of religious works; particularly an *Ecclesiastical History*, which exposed him to the resentment of the divines; and another giving an account of the doctrines and manners from the first ages, in which he frequently animadverts upon Cave's primitive Christianity. He died in 1714. Various are the opinions concerning Arnoldus in Germany; some of his own countrymen and profession extolling him to the skies as a saint of the last century, and setting an inestimable value upon his works; while others pronounce damnation upon him as an arch-heretic, and condemn his writings as heterodox.

ARNON (anc. geog.), a brook running between the borders of the Moabites and Ammonites on the other side Jordan (Moses, Joshua): Josephus calls it a river, rising on the borders of Arabia, and at length falling into the Dead Sea. It is also called the river of Gad, as appears 2 Sam. xxv. 5. compared with 2 Kings x. 33.

ARNOT, in botany, the English name of the bunium. See BUNIUM.

ARNOTTO. The same with Anotta. See ANOTTA and BIXA.

ARNSTADE, a town of Germany, in Thuringia, on the river Gera. E. Long. 11. 3. N. Lat. 50. 54.

ARNULPH, or ERNULPH, bishop of Rochester in the reign of Henry I. He was born in France, where he was sometime a monk of St Lucian de Beauvais. The monks led most irregular lives in this monastery; for which reason he resolved to quit it, but first took the advice of Lanfranc archbishop of Canterbury, under whom he had studied in the abbey of Becc, when Lanfranc was prior of that monastery. This prelate invited him over to England, and placed him in the monastery of Canterbury, where he lived a private monk till Lanfranc's death. When Anselm came to the archiepiscopal see, Arnulph was made prior of the monastery of Canterbury, and afterwards abbot of Peterborough. In 1115, he was consecrated bishop of Rochester, which see he held nine years, and died in March 1124, aged 84.

Arnulph wrote, 1. A piece in Latin concerning the foundation, endowment, charters, laws, and other things relating to the church of Rochester: it is generally known by the title of *Textus Roffensis*, and is preserved in the archives of the cathedral church of Rochester. 2. An Epistle in Answer to some Questions of Lambert abbot of Munster; and, 3. An Epistle on incestuous Marriage.

ARNUS, now *Arno*, a very rapid river of Tuscany, which it divides, and in its course washes Florence and Pisa; rising in the Apennine, to the east of Florence, near a village called *S. Maria della Gratie*, on the borders of Romagna, 15 miles to the west of the sources of the Tiber; and then turning southward towards Arretium, it is there increased by the lakes of the Clanis; after which it runs westward, dividing Florence into two parts, and at length washing Pisa, falls eight miles below it into the Tuscan Sea.

ARNWAY (John), a clergyman distinguished by his benevolence and loyalty to King Charles I. was descended from a very good family in the county of Salop, from which he inherited a considerable estate. He was educated at Oxford; and, having received holy orders, obtained the rectories of Hodnet and Ightfield, where he distinguished himself by his piety and exemplary charity: for it was his custom to clothe annually 12 poor people, and every Sunday to entertain as many at his table, not only plentifully, but with intimacy and respect. The civil war breaking out, he preached against rebellion, and raised and clothed eight troopers for the service of King Charles I. upon which his house was plundered by the parliament's army. He then went to Oxford to serve the king in person, which subjected him to a new train of misfortunes: for his estate was soon after sequestered, and himself imprisoned till the king's death; after which, he went to the Hague, where he published, 1. The Tablet, or the Moderation of Charles I. the Martyr; and, 2. An Alarm to the Subjects of England. He at last went to Virginia, where he died in 1653.

AROBE. See ARROBAS.

AROLEO, an American weight, equal to 25 of our pounds.

AROMA PHILOSOPHORUM, denotes either saffron, or the aroph of Paracelsus; as *aroma germanicum* denotes elecampane. See AROPH.

AROMATA (anc. geog.), a town of Lydia, famous for its generous wines; and hence the appellation (Strabo). Also the name of a trading town, and promontory of Ethiopia, at the termination of the Sinus Avalites of the red Sea (Arrian).

AROMATIC, an appellation given to such plants as yield a brisk fragrant smell, and a warm taste; as all kinds of spices, &c. See MATERIA MEDICA.

ARONA, a town of Italy, in the duchy of Milan, with a strong castle. It stands on the lake Maggiore. E. Long. 8. 25. N. Lat. 45. 41.

ARONCHES, a town of Portugal in Alantejo, on the confines of Spain, seated on the river Caro. It is well fortified, and has about 500 inhabitants. W. Long. 5. 16. N. Lat. 14. 39.

AROOL, a town of the empire of Russia, in the Ukrain, seated on the river Occa. E. Long. 38. 15. N. Lat. 51. 48.

AROPH, a contraction of *aroma philosophorum*; a name given to saffron.

AROPH Paracelsi, a name given to a kind of chemi-

cal

cal flowers, probably of the same nature with the Ens Veneris, elegantly prepared by sublimation from equal quantities of lapis hæmatitis and sal ammoniac.

AROPH is also a term used frequently by Paracelsus in a sense synonimous with *lithontriptic*.

AROSBAY, a town of the East Indies, on the coast of the island of Madura, near Java. E. Long. 14. 30. N. Lat. 9. 30.

AROURA, a Grecian measure of 50 feet. It was more frequently used for a square-measure of half the plethron. The Egyptian aroura was the square of 100 feet.

ARPAD (anc. geog.), is thought to have been a city of Syria. It was always placed with Hamath (2 Kings xviii. 34. xix. 13. Isai. x. 9. xxxvi. 19. xxxvii. 13. Jerem. xlix. 23.) Sennacherib boasts of having reduced Arpad and Hamath, or of having destroyed the gods of these two places. Hamath is known to be the same with Emesa; and it is thought that Arpad is the same with Arad or Arvad, as it is sometimes called in Hebrew. See ARAD.

ARPAGIUS, or HARPAGIUS, among the ancients, a person who died in the cradle, at least in early youth. The word is formed from the Greek αρπαζω, *I snatch*. The Romans made no funerals for their *arpagii*. They neither burnt their bodies, nor made tombs, monuments, or epitaphs for them; which occasioned Juvenal to say,

> ——*Terra clauditur infans*
> *Et minor igne rogi.*

In after times it became the custom to burn such as had lived to the age of 40 days, and had cut any teeth; and these they called Αρπακτοι, or Αρπαγμενοι, q. d. *rapti, ravished*. The usage seems to have been borrowed from the Greeks; among whom, Eustathius assures us, it was the custom never to bury their children either by night or full day, but at the first appearance of the morning; and that they did not call their departure by the name of *death*, but by a softer appellation, Ημερας αρπαγη, importing that they were ravished by Aurora, or taken away to her embraces.

ARPENT, signifies an acre or furlong of ground; and, according to the old French account in domesday-book, 100 perches make an arpent. The most ordinary acre, called *l'arpent de France*, is 100 perches square: but some account it but half an acre.

ARPHAXAD, the son of Shem and father of Salah. Arphaxad was born in the year of the world 1658, a year after the deluge, and died in the year of the world 2096, at the age of 438 years, (Genes. xi. 12, &c.)

ARPI. See *ARGOS Hippium*.

ARPINAS, or ARPINO, (Joseph Cæsar), a famous painter, born in the year 1560, at the castle of Arpinas, in the kingdom of Naples. He lived in great intimacy with Pope Clement VIII. who conferred upon him the honour of knighthood, and bestowed on him many other marks of his friendship. In the year 1600, he went to Paris with cardinal Aldobrandin, who was sent legate to the French court on the marriage of Henry IV. with Mary of Medicis. His Christian majesty gave Arpinas many considerable presents, and created him a knight of St. Michael. The colouring of this painter is thought to be cold and inanimate; yet there is spirit in his designs, and his compositions have somewhat of fire and elevation. The touches of his pencil being free and bold, give therefore pleasure to connoisseurs in painting; but they are generally incorrect. What he painted of the Roman history is the most esteemed of all his works. The French king has in his collection the following pieces of this master, viz. the nativity of our Saviour, Diana and Acteon, the rape of Europa, and a Susanna. He died at Rome in 1640.

ARPINUM, a town of the Volsci, a little to the east of the confluence of the rivers Liris and Fibrenus, in the Terra di Lavora; now decayed, and called *Arpino*. It was the native place of Cicero, and of C. Marius, (Sallust).

ARQUA, a town of Italy, in the Paduan, and territory of Venice, remarkable for the tomb of Petrarch. E. Long. 11. 43. N. Lat. 45. 43.

ARQUEBUS. See HARQUEBUS.

ARQUES, a town of Normandy, in France, seated on a small river of the same name. E. Long. 1. 30. N. Lat. 49. 54.

ARRACHEE, in heraldry, a term applied to the representations of plants torn up by the roots.

ARRACHIS, in botany. See ARACHIS.

ARRACK. See ARACK.

ARRAGON, a province of Spain, bounded on the north by the Pyrenæan mountains, which separate it from France; on the west, by Navarre and the two Castiles; on the south, by Valencia; and on the east, by Catalonia. It is in length about 180 miles, and in breadth 149; but the land is mountainous, dry, sandy or stony, badly cultivated, and worse peopled. However it does not want rivers: for besides the Ebro, which crosses it in the middle, there are the Xalo, the Cinea, the Galego, and the Arragon. The air is pure and wholesome; and there are mines of iron, and some say of gold. The most fertile parts are about the rivers: for there the land produces corn, wine, oil, flax, hemp, various fruits, and a small quantity of saffron, besides large flocks of sheep, and plenty of game in the woods.

The Arragonese have the character of being bold, courageous, and well-bred; but positive in their opinions, and bigotted in their religion. These were the first of the Spaniards that threw off the Moorish yoke. Saragossa is the capital of this province; and the other chief towns are Balbastro, Jaca, Sarazona, Haesca, Calatajud, Albarrazin, Trevel, Daroca, and Boria.

ARRAIGNMENT, in law, the arraigning or setting a thing in order, as a person is said to arraign a writ of novel disseisin, who prepares and fits it for trial.

ARRAIGNMENT is most properly used to call a person to answer in form of law upon an indictment, &c.

When brought to the bar, the criminal is called upon by name to hold up his hand; which, though it may seem a trifling circumstance, yet is of this importance, that by the holding up of his hand *constat de persona*, and he owns himself to be of that name by which he is called. However it is not an indispensable ceremony; for, being calculated merely for the purpose of identifying the person, any other acknowledgement will answer the purpose as well: therefore, if the prisoner obstinately and contemptuously refuses to hold

Arraignment. up in his hand, but confesses he is the person named, it is fully sufficient.

Then the indictment is to be read to him distinctly in the English tongue (which was law, even while all other proceedings were in Latin), that he may fully understand his charge. After which it is to be demanded of him, whether he be guilty of the crime whereof he stands indicted, or not guilty?

When a criminal is arraigned, he either stands mute, or confesses the fact, or else he pleads to the indictment.

1. If he says nothing, the court ought *ex officio* to impanel a jury to enquire whether he stands obstinately mute, or whether he be dumb *ex visitatione Dei*. If the latter appears to be the case, the judges of the court (who are to be of counsel for the prisoner, and to see that he hath law and justice) shall proceed to the trial, and examine all points as if he had pleaded not guilty. But whether judgment of death can be given against such a prisoner, who hath never pleaded, and can say nothing in arrest of judgment, is a point yet undetermined.

If he be found to be obstinately mute (which a prisoner hath been held to be that hath cut his own tongue), then, if it be on an indictment of high treason, it hath long been clearly settled, that standing mute is equivalent to conviction, and he shall receive the same judgment and execution.

The English judgment of penance for standing mute was as follows: That the prisoner be remanded to the prison from whence he came, and put into a low, dark chamber; and there be laid on his back, on the bare floor, naked, unless where decency forbids; that there be placed upon his body as great a weight of iron as he could bear, and more; that he have no sustenance, save only, on the first day, three morsels of the worst bread; and, on the second day, three draughts of standing water that should be nearest to the prison door; and in this situation this should be alternately his daily diet, *till he died*, or, as anciently the judgment ran, *till he answered*.

It hath been doubted whether this punishment subsisted at the common law, or was introduced in consequence of the statute Westm. 1. 3 Edw. I. c. 12. which seems to be the better opinion. For not a word of it is mentioned in Glanvil or Bracton, or in any ancient author, case, or record (that hath yet been produced), previous to the reign of Edward I.: but there are instances on record in the reign of Henry III. where persons accused of felony, and standing mute, were tried in a particular manner, by two successive juries, and convicted,; and it is asserted by the judges in 8 Henry IV. that, by the common law before the statute, standing mute on an appeal amounted to a conviction of the felony. This statute of Edward I. directs such persons, "as will not put themselves upon inquests of felonies before the judges at the suit of the king, to be put into hard and strong prison (*soient mys en la prisone fort et dure*), as those which refuse to be at the common law of the land." And, immediately after this statute, the form of the judgment appears in Fleta and Britton to have been only a very strait confinement in prison, with hardly any degree of sustenance; but no weight is directed to be laid upon the body, so as to hasten the death of the miserable sufferer: and indeed any surcharge of punishment on persons adjudged to penance, so as to shorten their lives, is reckoned by Horne in the Mirror as a species of criminal homicide. It also clearly appears, by a record of 31st Edw. III. that the prisoner might then possibly subsist for forty days under this lingering punishment. It is therefore imagined that the practice of loading him with weights, or, as it is usually called, *pressing him to death*, was gradually introduced between 31 Edward III. and 8 Henry IV. at which last period it first appears upon the books; being intended as a species of mercy to the delinquent, by delivering him the sooner from his torment: and hence it is also probable, that the duration of the penance was then first altered; and instead of continuing *till he answered*, it was to continue *till he died*, which must very soon happen under an enormous pressure.

The uncertainty of its original, the doubts that were conceived of its legality, and the repugnance of its theory (for it rarely was carried into practice) to the humanity of the laws of England, all concurred to require a legislative abolition of this cruel process, and a restitution of the ancient common law; whereby the standing mute in felony, as well as in treason—as in trespass, amounted to a confession of the charge.

2. If the prisoner made a simple and plain confession, the court hath nothing to do but to award judgment: but it is usually very backward in receiving and recording such confession, out of tenderness to the life of the subject; and will generally advise the prisoner to retract it, and,

3. Plead to the indictment; as to which, see the article *PLEA of Indictment*.

ARRAN, an island of Scotland, in the Frith of Clyde, between Kintyre and Cunningham. Of this island the best description we have is that given by Mr Pennant, in his Tour through Scotland, Vol. II. 172.—184.

"Arran, or properly *Arr-inn*, or 'the island of mountains,' seems not to have been noticed by the ancients, notwithstanding it must have been known to the Romans, whose navy, from the time of Agricola, had its station in the *Glota Æstuarium*, or the Frith of Clyde. Camden indeed makes this island the Glota of Antonine, but no such name occurs in his itinerary: it therefore was bestowed on Arran by some of his commentators. By the immense cairns, the vast monumental stones, and many relics of Druidism, this island must have been considerable in very ancient times. Here are still traditions of the hero Fingal, or Fin-mac-coul, who is supposed here to have enjoyed the pleasures of the chace; and many places retain his name: but I can discover nothing but oral history that relates to the island till the time of Magnus the Barefooted, the Norwegian victor, who probably included Arran in his conquests of Kintyre, if he did not conquer that island, it was certainly included among those that Donald-bane was to cede; for it appears that Acho, one of the successors of Magnus, in 1263 laid claim to Arran, Bute and the Cumrays, in consequence of that promise: the two first he subdued, but the defeat he met with at Largs soon obliged him to give up his conquests. Arran was the property of the crown. Robert Bruce retired thither during his distresses, and met with protection from his faithful vassals. Numbers of them followed his fortunes, Arran.

fortunes; and after the battle of Bannock-burn he rewarded several, such as the Mac-cooks, Mackinnons, Mac-brides, and Mac-louis, or Fullerton's, with different charters of lands in their native country. All these are now absorbed by this great family, except the Fullerton's, and a Stewart, descended from a son of Robert III. who gave him a settlement here. In the time of the Dean of the Isles, his descendant possessed Castle Douan; and *he and his bluid*, says the Dean, *are the best men in that countrey*. About the year 1334, this island appears to have formed part of the estate of Robert Stewart, great steward of Scotland, afterwards Robert II. At that time they took arms to support the cause of their master; who afterwards, in reward, not only granted at their request an immunity from their annual tribute of corn, but added several new privileges, and a donative to all the inhabitants that were present. In 1456, the whole island was ravaged by Donald Earl of Ross and Lord of the Isles. At that period, it was still the property of James II.; but in the reign of his successor James III. when that monarch matched his sister to Thomas Lord Boyd, he created him Earl of Arran, and gave him the island as a portion. Soon after, on the disgrace of that family, he caused the countess to be divorced from her unfortunate husband; and bestowed both the lady and island on Sir James Hamilton, in whose family it continues to this time, a very few farms excepted.

"Arran is of great extent, being 23 miles from Sgreadan point north to Beinnean south; and the number of inhabitants are about 7000, who chiefly inhabit the coasts; the far greater part of the country being uninhabited by reason of the vast and barren mountains. Here are only two parishes, Kilbride and Kilmore; with a sort of chapel of ease to each, founded in the last century, in the golden age of this island, when it was blessed with Anne Duchess of Hamilton, whose amiable disposition and humane attention to the welfare of Arran render at this distant time her memory dear to every inhabitant. The principal mountains of Arran are, Goatfield, or Gaoilbheinn, or "the mountain of the winds, of a height equal to most of the Scottish Alps, composed of immense piles of moorstone, in form of wool-packs, clothed only with lichens and mosses, inhabited by eagles and ptarmigans; Beinbharrain, or, "the sharp-pointed;" Ceum-na-caillich, "the step of the carline or old hag; and Grianan-Athol, that yields to none in ruggedness. The lakes are, Loch-jorsa, where salmon come to spawn; Loch-tana; Loch-nah-jura, on the the top of a high hill; Loch-mhachrai; and Loch-knoc-a-charbeil, full of large eels. The chief rivers are, Abhan-mhor, Moina-mhor, Slondrai-machrei, and Jorsa; the two last remarkable for the abundance of salmon.

"The quadrupeds are very few; only otters, wild-cats, shrew-mice, rabbits and bats: the stags which used to abound, are reduced to about a dozen. The birds are, eagles, hooded-crows, wild-pigeons, stares, black game, grous, ptarmigans, daws, green plovers, and curlews. It may be remarked, that the partridge at present inhabits this island, a proof of the advancement of agriculture.

"The climate is very severe: for besides the violence of wind, the cold is very rigorous; and snow lay here in the valley for 13 weeks of the last winter. In summer, the air is remarkably salubrious; and many invalids resort here on that account, and to drink the whey of goats milk.

"The principal disease here is the pleurisy: small-pox, measles, and chincough, visit the island once in seven or eight years. The practice of bleeding twice every year seems to have been intended as a preventative against the pleurisy: but it is now performed with the utmost regularity at spring and fall. The duke of Hamilton keeps a surgeon in pay; who at those seasons makes a tour of the island. On notice of his approach, the inhabitants of each farm assemble in the open air; extend their arms and are bled into a hole made in the ground, the common receptacle of the vital fluid. In burning fevers, a tea of *wood sorrel* is used with success, to allay the heat. An infusion of *ramsons*, or *allium ursinum*, in brandy, is esteemed here a good remedy for the gravel.

"The men are strong, tall, and well made; all speak the Erse language, but the ancient habit is entirely laid aside. Their diet is chiefly potatoes and meal; and during winter some dried mutton or goat is added to their hard fare. A deep dejection appears in general through the countenances of all: no time can be spared for amusement of any kind; the whole being given for procuring the means of paying their rent, or laying in their fuel, or getting a scanty pittance of meat and clothing.

"The leases of farms are 19 years, the succeeding tenants generally find the ground little better than a *caput mortuum:* and for this reason; Should they at the expiration of the lease leave the lands in a good state, some avaricious neighbours would have the preference in the next setting, by offering a price more than the person who had expended part of his substance in enriching the farm could possibly do. This induces them to leave it in the original state. The method of setting a farm is very singular; each is commonly possessed by a number of small tenants; thus a farm of 40*l.* a year is occupied by 18 different people, who by their leases are bound, conjunctly and severally, for the payment of the rent to the proprietor. These live in the farm in houses clustered together, so that each farm appears like a little village. The tenants annually divide the arable land by lot; each has his ridge of land to which he puts his mark, such as he would do to any writing: and this species of farm is called *run-rig*, i. e. ridge. They join in ploughing; every one keeps a horse or more; and the number of those animals consume so much corn as often to occasion a scarcity; the corn and peas raised being (much of it) designed for their subsistence, and that of the cattle during the long winter. The pasture and moor-land annexed to the farm is common to all the possessors. All the farms are open. Inclosures of any form, except in two or three places, are quite unknown: so that there must be a great loss of time in preserving their corn, &c. from trespass. The usual manure is sea-plants, coral, and shells. The run-rig farms are now discouraged: but since the tenements are set by roup or auction, and advanced by an unnatural force to above double the old rent, without any allowance for inclosing, any example set in agriculture, any security of tenure by lengthening the leases, affairs will turn retrograde, and the farms relapse into their old state of rudeness;

migration

migration will increase (for it has begun), and the rents be reduced even below their former value: the late rents were scarce 1200l. a-year; the expected rents 3000l.

"The produce of the island is oats; of which about 5000 bolls, each equal to nine Winchester bushels, are sown; 500 of beans, a few peas, and above 1000 bolls of potatoes, are annually set: notwithstanding this, 500 bolls of oat-meal are annually imported, to subsist the natives.

"The live stock of the island is 3183 milch-cows; 2000 cattle, from one to three years old; 1058 horses; 1500 sheep; and 500 goats: many of the two last are killed at Michaelmas, and dried for winter-provision, or sold at Greenock. The cattle are sold from 40 to 50s. per head, which brings into the island about 1200l. per annum: I think that the sale of horses also brings in about 300l. Hogs were introduced here only two years ago. The herring-fishery round the island brings in 300l. the sale of herring-nets 100l. and that of thread about 300l. for a good deal of flax is sown here. These are the exports of the island; but the money that goes out for mere necessaries is a melancholy drawback.

"The women manufacture the wool for the cloathing of their families; they set the potatoes, and dress and spin the flax. They make butter for exportation, and cheese for their own use.

"The inhabitants in general are sober, religious, and industrious; great part of the summer is employed in building or repairing their houses, for the badness of the materials requires annual repairs: before and after harvest; they are busied in the herring-fishery; and during winter the men make their herring-nets; while the women are employed in spinning their linen and woollen yarn. The light they often use is that of lamps. From the beginning of February to the end of May, if the weather permits, they are engaged in labouring their ground: in autumn they burn a great quantity of fern, to make kelp. So that, excepting at new year's day, at marriages, or at the two or three fairs in that island, they have no leisure for any amusements: no wonder then at their depression of spirits.

"Arran forms part of the county of Bute, and is subject to the same sort of government: but, besides, justice is administered at the baron's baily-court, who has power to fine as high as 20s.; can decide in matters of property not exceeding 40s.; can imprison for a month; and put delinquents into the stocks for three hours, but that only during day-time."

In this island there are many of those rude antiquities or monuments called *cairns*, *druidical circles*, &c. See CAIRNS.

ARRANGEMENT, or RANGEMENT, the disposition of the parts of a whole, in a certain order.

The modern philosophy shows us, that the diversity of the colours of bodies depends entirely on the situation and arrangement of the parts, which reflect the light differently; the diversity of tastes and smells on the different arrangements of the pores, which render them differently sensible; and the general diversity of bodies on the different arrangement of their parts. The happy arrangement of words makes one of the greatest beauties of discourse.

ARRAS, the capital city of Artois, a province in the French Netherlands. It is seated on a mountain; and the parts about it are full of quarries, where they get stone for building. It is divided into two parts, the town and the city. The abbe of St Vaast is lord of the town, and the bishop of Arras of the city, which is the least part. They are divided by a strong wall, a large fosse, and the little river Chrinchron, which 100 paces below falls into the Scarp. They are both well fortified, inclosed by high ramparts, and by double deep fosses, which in several places are cut out of the rock. It has four gates; and since the French are become masters of it, has a strong citadel with five bastions. The most remarkable places are, the great square where the principal market is kept; this is full of fine buildings, with piazzas all round it like those of Covent-garden. Not far from this is the lesser market, which contains the town-house, a very noble structure, with a high tower covered with a crown, on the top of which is a brazen lion which serves for a vane. In the midst of this market is the chapel of the Holy Candle, which the papists pretend was brought by the Virgin Mary herself above 600 years ago, when the city was afflicted with divers diseases, and every one that touched the candle was cured; it is kept in a silver shrine. This chapel has a spire-steeple, adorned with several statues. The cathedral church of Notre-Dame stands in the city: it is a very large Gothic building, extremely well adorned; the tower is very high, and has a fine clock embellished with little figures in bronze, which represent the passion of Jesus Christ; they pass before the bell to strike the hours and half hours. In this church there is a silver shrine, enriched with pearls and diamonds, which contains a sort of wool, which they call *manna*; that they say fell from heaven in the time of a great drought, almost 1400 years ago: they carry it very solemnly in procession when they want rain. The abbey-church of St Vedast is the greatest ornament of Arras, it being adorned with a fine steeple, and seats for the monks of admirable workmanship; the pulpit is of brass, fashioned like a tree, supported by two bears of the same metal, sitting on their hind legs; there are little bears in different postures coming to climb up the tree. The chimes are remarkable for the different tunes which they play. There are 11 parish churches, and a great many convents of men and women. It is from this city that the tapestry called *arras hangings* takes its denomination. E. Long. 2. 56. N. Lat. 50. 17.

ARRAS, or *Araxes*, is also the name of a river of Georgia, which discharges itself into the Caspian sea.

ARRAY, in law, the ranking or setting forth of a jury, or inquest of men impanelled on a cause.

Battle-ARRAY, the order or disposition of an army, drawn up with a view to engage the enemy. See ARMY.

ARRAYERS, or ARRACERS, ARRAITORES, is used, in some ancient statutes, for such officers as had care of the soldiers armour, and saw them duly accoutred in their kinds. In some reigns, commissioners have been appointed for this purpose. Such were the commissioners of array appointed by king Charles I. in the year 1642.

ARREARS, the remainder of a sum due, or money remaining in the hands of an accountant. It likewise signifies

signifies the money due for rent, wages, &c. or what remains unpaid of pensions, taxes, &c.

ARRENTATION, in the forest laws, implies the licensing the owner of lands in a forest to inclose them with a low hedge and a small ditch, in consideration of a yearly rent.

ARREST, in English law (from the French word *arrester*, to *stop* or *stay*), is the restraint of a man's person, obliging him to be obedient to the law; and is defined to be the execution of the command of some court of record or office of justice. An arrest is the beginning of imprisonment; where a man is first taken, and restrained of his liberty, by power or colour of lawful warrant.

Arrests are either in *civil* or *criminal* cases.

1. An arrest in a *civil cause* is defined to be the apprehending or restraining one's person by process in execution of the command of some court.

An arrest must be by corporal seising or touching the defender's body; after which the bailiff may justify breaking open the house in which he is, to take him: otherwise he has no such power; but must watch his opportunity to arrest him. For every man's house is looked upon by the law to be his castle of defence and asylum, wherein he should suffer no violence. Which principle is carried so far in the civil law, that, for the most part, not so much as a common citation or summons, much less an arrest, can be executed upon a man within his own walls. Peers of the realm, members of parliament, and corporations, are privileged from arrests; and of course from outlawries. And against them the process to inforce an appearance must be by summons and distress *infinite*, instead of a *capias*. Also clerks, attorneys, and all other persons attending the courts of justice (for attorneys, being officers of the court, are always supposed to be there attending), are not liable to be arrested by the ordinary process of the court, but must be sued by bill (called usually a *bill of privilege*) as being personally present in court. Clergymen performing divine service, and not merely staying in the church with a fraudulent design, are for the time privileged from arrests, by statute 50 Edw. III. c. 5. and 1 Rich. II. c. 86.; as likewise members of convocation actually attending thereon, by statute 1 Hen. VI. c. 1. Suitors, witnesses, and other persons, necessarily attending any courts of record upon business, are not to be arrested during their actual attendance, which includes the necessary coming and returning. Seamen in the king's service are privileged from arrests for debts under L.20. (1 Geog. II. c. 14. and 14 Geo. II. c. 38.); and soldiers or marines are not liable to arrests for a debt of less than L.10. (30 Geo. II. c. 6, 11.) And no arrest can be made in the king's presence, nor within the verge of his royal palace, nor in any place where the king's justices are actually sitting. The king hath moreover a special prerogative (which indeed is very seldom exerted), that he may by his *writ of protection* privilege a defendant from all personal, and many real, suits, for one year at a time, and no longer, in respect of his being engaged in his service out of the realm. And the king also by the common law might take his creditor into his protection, so that no one might sue or arrest him till the king's debt was paid: but by the statute 25 Edw. III. c. 19. notwithstanding such protection, another creditor may proceed to judgment against him, with a stay of execution, till the king's debt be paid; unless such creditor will undertake for the king's debt, and then he shall have execution for both. And, lastly, by statute 29 Car. II. c. 7. no arrest can be made, nor process served, upon a Sunday, except for treason, felony, or breach of the peace.

2. An arrest in *criminal cause* is the apprehending or restraining one's person, in order to be forthcoming to answer an alleged crime. To this arrest all persons whatsoever are, without distinction, equally liable; and doors may be broken open to arrest the offender: but no man is to be arrested, unless charged with such a crime as will at least justify holding him to bail when taken. There is this difference also between arrests in civil and criminal cases, that none shall be arrested for debt, trespass, or other cause of action, but by virtue of a precept or commandment out of some court; but for treason, felony, or breach of the peace, any man may arrest with or without warrant or precept. But the king cannot command any one by word of mouth to be arrested; for he must do it by writ, or order of his courts, according to law: nor may the king arrest any man for suspicion of treason, or felony, as his subjects may; because, if he doth wrong, the party cannot have an action against him.

Arrests by private persons are in some cases commanded. Persons present at the committing of a felony must use their endeavours to apprehend the offender, under penalty of fine and imprisonment; and they are also, with the utmost diligence, to pursue and endeavour to take all those who shall be guilty thereof out of their view, upon a hue and cry levied against them. By the vagrant act 17 Geo. II. c. 5. every person may apprehend beggars and vagrants; and every private person is bound to assist an officer requiring him to apprehend a felon.

In some cases likewise arrests by private persons are rewarded by law. By the 4 and 5 William and Mary, c. 8. persons apprehending highwaymen, and prosecuting them to a conviction, are intitled to a reward of L.40, and if they are killed in the attempt, their executors, &c. are intitled to the like reward. By the 6 and 7 William III. c. 17. persons apprehending counterfeiters and clippers of the coin, and prosecuting them to conviction, are intitled to L.40.

By 5 Ann, c. 31. persons who shall take any one guilty of burglary, or the felonious breaking and entering any house in the day-time, and prosecute them to conviction, shall receive the sum of L.40 within one month after such conviction.

With regard to arrests by public officers, as watchmen, constables, &c. they are either made by their own authority, which differs but very little from the power of a private person; or they are made by a warrant from a justice of peace. See WARRANT.

ARREST of Judgment, in law, the assigning just reason why judgment should not pass: as, Want of notice of the trial; a material defect in the pleading; when the record differs from the deed impleaded; when persons are misnamed; where more is given by the verdict than is laid in the declaration, &c. This may be done either in criminal or civil cases.

ARRESTMENT, in Scots law, signifies the securing of a criminal till trial, or till he find caution to stand trial, in what are called *bailable crimes*. In civil cases, it signifies either the detaining of strangers or natives *in meditatione fugæ*, till they find caution *judicio sisti*, or the attaching the effects of a stranger in order to found jurisdiction. But, in the most general acceptation of the word, it denotes that diligence by which a creditor detains the goods or effects of his debtor in the hands of third parties till the debt due to him be either paid or secured. See LAW, Part III. Nº clxxviii.

ARRESTO FACTO SUPER BONIS, &c. a writ brought by a denizen against the goods of aliens found within the kingdom, as a recompence for goods taken from him in a foreign country.

ARRESTS, in farriery, mangy tumors upon a horse's hinder-legs, between the ham and the pastern.

ARRETIUM, (Cicero, Cæsar); *Arrhetium*, (Ptolemy); *Urbs Arrhetinorum*, (Polybius); one of the twelve ancient towns of Tuscany, near the Arnis and Clanis, situated in a pleasant valley. Now *Arezzo*, 42 miles east of Florence. E. Long. 13. 18. Lat. 43. 15.

ARRHABONARII, a sect of Christians, who held that the Eucharist is neither the real flesh or blood of Christ, nor yet the sign of them; but only the pledge or earnest thereof.

ARRHEPHORIA, a feast among the Athenians, instituted in honour of Minerva, and Herse, daughter of Cecrops. The word is composed of αρρητον, *mystery*, and φερω, *I carry*; on account of certain mysterious things which were carried in procession at this solemnity.—Boys, or, as some say, girls, between seven and twelve years of age, were the ministers that assisted at this feast, and were denominated αρρηφοροι. This feast was also called *Hersiphoria*, from the daughter of Cecrops, already mentioned.

ARRIAN, a famous philosopher and historian under the emperor Hadrian and the two Antonines, was born at Nicomedia in Bithynia. His great learning and eloquence procured him the title of *The second Xenophon;* and raised him to the most considerable dignities at Rome, even the consulship itself. We have four books of his *Dissertations upon Epictetus*, whose scholar he had been; and his *History of Alexander the Great*, in seven books, is greatly admired by the best judges.

ARRIERE, the hinder or posterior part of any thing.

ARRIERE Ban, in the French customs is a general proclamation, whereby the king summons to the war all that hold of him, both his vassals, i. e. the noblesse, and the vassals of his vassals.

ARRIERE Fee, or *Fief*, is a fee dependent on a superior one. These fees commenced, when the dukes and counts, rendering their governments hereditary in their families, distributed to their officers parts of the royal domains which they found in their respective provinces, and even permitted those officers to gratify the soldiers under them in the same manner.

ARROBAS, or AROBAS, a weight used in Spain, Portugal, and the foreign dominions of both. The Arrobas of Portugal is also called *Arata*, and contains thirty-two Lisbon pounds; that of Spain contains twenty-five Spanish pounds. In Peru it is called *Arrove*.

ARROE, a small island of Denmark, in the Baltic Sea, a little south of the island of Funen. It is eight miles in length, and about two in breadth; and produces corn, anniseed, black cattle, and horses. It has three parishes, the most considerable of which is Koping. It stands at the south-side of the island, in the bottom of a bay, and has a port with some trade. E. Long. 9. 40. N. Lat. 55. 20.

ARROJO, DE ST SERVAN, a town in Spain, in Estramadura. W. Long. 5. 20. N. Lat. 38. 40.

ARRONDEE, in heraldry, a cross, the arms of which are composed of sections of a circle, not opposite to each other, so as to make the arms bulge out thicker in one part than another; but the sections of each arm lying the same way, so that the arm is every where of an equal thickness, and all of them terminating at the edge of the escutcheon like the plain cross.

ARROW, a missive weapon of offence, slender, pointed and barbed, to be cast or shot with a bow. See ARCHERY.

ARROW-Makers are called *fletchers;* and were formerly, as well as bowyers, persons of great consequence in the commonwealth.

Arrow-heads and quarrels were to be well boched or brased, and hardened at the points with steel: the doing of which seems to have been the business of the arrow-smith.

ARROW-Head, in botany. See SAGITTARIA.

ARROW-Root. See MARANTA.

ARSACES, otherwise MITHRIDATES, a king of the Parthians, spoken of in the first book of Maccabees, xiv. 2. He considerably enlarged the kingdom of Parthia by his good conduct and valour. See PARTHIA.

ARSCHIN, in commerce, a long measure used in China to measure stuffs. Four arschins made three yards of London.

ARSENAL, a royal or public magazine, or place appointed for the making or keeping of arms, necessary either for defence or assault. Some derive this word from *arx*, a *fortress*; others from *ars*, denoting a *machine;* others again from *arx* and *senatus*, because this was the defence of the senate: but the more probable opinion derives it from the Arabic *darsenaa*, which signifies *arsenal*.

The arsenal of Venice is the place where the galleys are built and laid up. The arsenal of Paris is that where the cannon or great guns are cast. It has this inscription over the gate:

Ætna hæc Henrico vulcania tela ministrat,
Tela Gigantæos debellatura furores.

There are arsenals, or store-houses, appropriated to naval furniture and equipments. At Marseilles is the arsenal for the galleys; and at Toulon, Rochefort, and Brest, are those for the men of war.

ARSENIC, in mineralogy and chemistry, an heavy opake substance, usually sold in white masses, which, when broken, discover a semi-transparency somewhat resembling that of sal ammoniac, but by exposure to the air become white and opake like the outside of the original mass. By various chemical processes it may be

Arsenic.

be made to assume the appearance either of an acid salt or metal, at the pleasure of the operator; and therefore has been considered both as a saline substance and as a semi-metal. It is not known at what time this mineral was discovered; though as it abounds in many different kinds of ores, it is probable that the pernicious properties it manifests would very soon make it be taken notice of by metallurgists. Aristotle makes mention of a substance called Σανδαρακη; and his disciple Theophrastus makes mention of one named Αρρενικον, which by Dioscorides and others was called Αρσενικον, about the beginning of the Christian æra. By this, however, it appears, that they only meant the substances now called *Sandarach* and *orpiment*; and Avicenna, who lived in the 11th century, is the first who expressly mentions white arsenic, as well as its sublimate. It is not known by whom arsenic was first reduced to a metallic form. Paracelsus asserts that arsenic, sublimed with egg-shell lime becomes like silver; and, in 1675, M. Lemeri makes mention of a method of subliming arsenic with fixed alkali and soap.

1 Is not mentioned till the time of Avicenna.

The true nature of arsenic being thus so little known, it is no wonder to find chemists differing very much as to the class of natural bodies in which it ought to be placed. Avicenna and a great number of others class it with the sulphurs; Albertus Magnus and his followers, among the salts. Becher considers it as a kind of soap, or saline suphureous body. Later experiments, however, have made it evident, that white arsenic consists of an acid united to phlogiston; and that by diminishing the latter, the acid becomes more and more apparent; while, on the contrary, by augmenting the quantity of phlogistic matter, the arsenic assumes the metallic form. With respect to the sulphureous nature of arsenic, it appears indeed that the regulus itself, as well as orpiment and realgar, are inflammable substances; but it is not so with white arsenic. This inflammability, therefore, which arsenic in a certain state has in common with zinc and several other substances, will not denominate it sulphureous, any more than those of other bodies which possess the common property of inflammability can be denominated *sulphurs*.

2 Composed of an acid and phlogiston.

It is commonly said that arsenic mineralizes metals; and therefore, says Mr Bergman, it is considered as a sulphur by some, who yet extend the idea of mineralization so far, as under it to comprehend all mixtures of which metals make a part. But if we examine this signification a little more accurately, we shall see that it is extended too far; for if this be admitted, we must at the same time allow, that no native metal is to be found. Thus the gold called *native*, is seldom if ever found pure, but more or less mixed with copper or silver; and so with other metals. If, therefore, arsenic, which, unless in its reguline state, never dissolves other metals, be considered as a mineralizing substance, what hinders us from saying that gold is mineralized by silver or copper, and in general every metal mineralized by some other? It is much more natural to suppose that those metals are mineralized which are actually dissolved and concealed by a menstruum. Sulphur is the chief agent employed by nature for this purpose; and though the acids of vitriol, phosphorus, nitre, and sometimes even the aërial acid, occasion the metals to put on an appearance foreign to their nature, yet the number of these is so small, that, compared with the sulphurated minerals, they almost vanish.

3 Is not to be considered as a substance by which other metals are mineralized.

4 Sulphur the chief mineralizer of metals.

This mineral, so troublesome to the mineralogist, occasioned the alchemists to suspect the existence of a certain arsenical principle indispensibly necessary to the perfection of every metal. Even as late as 1773 a question to this purpose was proposed by the Royal Academy of Sciences at Berlin: the prize was adjudged to M. Monnet, who, in his answer considered arsenic as a semi-metal of a peculiar kind, which is so far from constituting any essential part of metals, that its presence is always attended with inconveniences, either by carrying off the metal as it flies away, or spoiling the mass in which it remains. These considerations, however, do not hinder us from asserting that the acid of arsenic, like others, is a mineralizing substance, if at any time it happens to meet with metals in the bowels of the earth, and to unite with it in that form.

5 An arsenical principle erroneously supposed necessary for the perfection of metals.

6 Acid of arsenic a mineralizing substance.

Arsenic in its pure state is well known to be a most destructive and deadly poison, for which the art of medicine has scarcely as yet afforded a cure. Mr Bergman is of opinion that it acts as an highly corrosive acid, even when applied externally. He also tells us, that the dry acid is more destructive than white arsenic; the regulus and realgar less so. From an experiment of Mr. Scheele, however, in which eight grains of arsenic were given to a cat, it does not appear that it acts more violently than white arsenic. The extreme danger attending this substance when taken into the human body, arises from its insolubility, and the difficulty of decompounding it; for there can but little danger arise from a liquid, unless, like corrosive acids, it should at once burn the substance of the stomach like fire: or, like laurel-water suspend the action of the nervous system. Corrosive sublimate, solutions of mercury in aquafortis, &c. will as certainly poison as arsenic; but they are much less difficult to cure, because any alkaline substance will certainly decompound them and destroy their deleterious efficacy. Arsenic, on the contrary, cannot be decompounded, nor united with any known substance, at least in such a short time as the exigence of the case we speak of would require, without a considerable degree of heat. It therefore remains in the stomach, continually exerting its mischievous qualities, unless it can be discharged by vomiting.

7 Poisonous qualities of arsenic and its acid.

8 Why it is more dangerous than other.

The symptoms attending arsenic when swallowed are, nausea, sickness, and retching to vomit, about half an hour after it is taken. These are followed by violent vomitings, hiccups, and pains in the stomach and bowels. Convulsions and palsies of the limbs presently succeed, with intense heats, cold sweats, palpitation of the heart, extreme anxiety, prostration of strength, thirst and dryness of the mouth and throat, loss of reason, and at last death. If the quantity taken was considerable, the patient dies in seven or eight hours after taking it; and the stomach and intestines are found, upon dissection, to be corroded and perforated. When this is not the case, violent putrefactive symptoms soon ensue after arsenic is swallowed; for the bodies of those who are poisoned by it generally have abundance of red or purple spots even before death. It remarkably inflames the coats of the stomach, and the putrefaction

9 Symptoms attending the swallowing of arsenic.

 faction is ſaid particularly to take place in the genitals of men. Mr Bergman relates, that in the body of a man who was poiſoned with arſenic and diſſected in the anatomical theatre at Upſal, the putrefaction had been ſo ſtrong that the mineral was deprived of part of its phlogiſton, and emitted the garlic ſmell, that peculiar characteriſtic of arſenic when in this ſituation.

10 Antidotes ineffectually propoſed.

Many antidotes have been propoſed againſt this dreadful poiſon by authors of the higheſt reputation; but it is to be feared without that ſucceſs which the confidence of thoſe who propoſed them ſeemed to enſure. Indeed, previous to any great hope of ſucceſs in this reſpect, it ought to be ſhown that theſe antidotes are able to effect ſome conſiderable change on arſenic when out of the body; and that not in ſolution, but when in a powder not very fine, as is the caſe with arſenic when it is uſually taken. Mr Bergman, recommends alkalies in diſeaſes occaſioned by arſenic: Nay he tells us, that "ſince phlogiſton and alkalies are the moſt powerful correctors of acid acrimony, it will *readily occur*, how it may be mitigated, and its deleterious effects obviated." But the many fatal accidents conſequent on taking this mineral, ſhow that none of thoſe are to be depended upon. Bergman himſelf indeed cautions us againſt truſting to phlogiſton correctors alone; and perhaps the ſolution of hepar ſulphuris, which contains the united powers of both the alkaline and phlogiſtic antidotes united, might prove more efficacious than either of them ſingly. Oils, fats, milk, warm fat broths, freſh butter, &c. have all been recommended; and, no doubt, in ſuch deplorable caſes, are thoſe remedies to which we can moſt readily have recourſe: but even here it is evident that their efficacy muſt be exceedingly dubious, whatever their intrinſic virtues may be; and for this plain reaſon, that the arſenic is already in contact with the ſtomach, and tho' the remedies might have prevented its action had they been *firſt* ſwallowed, their operation muſt be much leſs powerful after the poiſon has had acceſs to the ſtomach and begun to exert its pernicious effects.

11 Arſenic recommended as a medicine both internally and externally.

Notwithſtanding theſe dreadful effects of arſenic when taken in large quantity, attempts have not been wanting to introduce it into the materia medica. The diſeaſe indeed in which they have been recommended (the cancer) is of a very incurable nature, at leaſt by ordinary medicines. M. le Febure, a French phyſician, ſome time ago publiſhed a treatiſe, in which he recommended pure white arſenic as a ſpecific in that diſtemper. The doſe was four French grains, equal to 3¼ Engliſh, diſſolved in a French pint (32 troy ounces) of diſtilled water. A table-ſpoonful of this ſolution is to be taken with an equal quantity of milk, and half an ounce of ſyrup of poppies, every morning faſting, and taking care to taſte nothing for an hour after. This courſe muſt be continued eight days; after which a doſe is to be taken twice every day in the ſame manner, one in the morning and another about eight at night. At the end of a fortnight three doſes may be exhibited daily, the third being taken at mid-day. Thus people of a weakly conſtitution may continue till the cure is completed; but ſuch as are more robuſt may gradually augment the doſe till two table-ſpoonfuls are taken at each time with as much milk, and half an ounce of ſyrup of poppies. Children muſt on no account take more than three tea-ſpoonfuls a day, with a proportional quantity of ſyrup of poppies. For adults, the ſtrength of the ſolution, as well as the quantity, is to be augmented; ſix grains being put into the ſecond bottle and eight into the third; and a purgative, compoſed of manna, rhubarb, and ſal ſeignette, is to be given every eight or twelve days. An iſſue he conſiders as uſeful in every caſe. The tumor, if not ulcerated, ought to be waſhed with a ſolution of arſenic in the proportion of eight grains to a pint; and he adviſes the following cataplaſm. "Take of carrot juice one pound, of ſugar of lead half an ounce, of arſenic, diſſolved in diſtilled vinegar, half an ounce, of liquid laudanum a dram and an half; form the whole into a maſs with as much powder of hemlock as is ſufficient for the purpoſe. The tumor is to be covered to a moderate thickneſs with this cataplaſm, which is to be kept on by a diachylon plaſter." When the cancer is of the ulcerated kind, he directs the ichorous ſeroſity to be taken away by means of dry *charpee* at each dreſſing, and the ſore to be fomented with the arſenical ſolution with the chill taken off it, and having about a third-part of red wine added to it. When the ſore is of a very bad kind, he propoſes the arſenic to be diſſolved in decoction of bark for the purpoſe of fomentation; after which the cataplaſm and plaſter are to be applied, and this is to be renewed every twelve hours.

Mr Le Febure aſſerts, that the arſenic, when taken with the precautions juſt mentioned, is not attended with any bad conſequences, nor has it a diſagreeable taſte. Its action is ſcarcely perceived on any of the ſecretions or excretions; though ſome diſcharge their urine more freely than uſual, and with ſome the belly is more looſe. In ſome the perſpiration is more copious; but theſe effects are neither regular nor conſtant. He does not conſider it as an infallible cure for the diſtemper in every poſſible ſtage; but thinks that the diſeaſe is incurable, when, in its progreſs, it has eroded a blood-veſſel, and occaſioned a conſiderable hemorrhagy; alſo when the patient is of a hectic or phthiſical habit of body. With reſpect to regimen, he directs whey, with twelve grains of nitre to the bottle, or a weak decoction of althea with an equal quantity of nitre; and to abſtain from wine and fermented liquors. Broth made with beef, veal, or chicken, is alſo proper.

12 Mr Bergman's opinion.

Mr Bergman informs us, that "it can hardly be doubted but arſenic may be applied to valuable purpoſes in medicine, and experiments have long ago put that out of doubt; but with reſpect both to its doſe and preparation, the utmoſt caution is neceſſary."

13 The internal exhibition of arſenic diſapproved by Dr Black.

Dr Black, however, has ſeen the internal exhibition of arſenic, in thoſe caſes where it is recommended by foreign phyſicians, attended with very dangerous conſequences, ſuch as hectics, &c. He has likewiſe known obſtinate ulcers healed by it. Yet though the external uſe of arſenic has proved ſucceſsful in ſome caſes, it has often, even in this way, produced very terrible conſequences: ſo that the Doctor, far from recommending the internal uſe of it, reprobates it even in external applications.

As phyſicians are often called in caſes where it is ſuſpected that people have died from the effects of arſenic

Arsenic.

Lectures on Chemistry.

14
Directions to a physician how to act when called in cases of arsenic being swallowed.

senic taken internally, Doctor Black gives the following directions to the physician who happens to be thus employed.

"He should answer every question put to him with caution, as the lives and reputations of many often depend on his opinions.

"The first question usually put is, Whether, from the symptoms of the patient, or the appearance of the body after death, he imagines the deceased died by being poisoned with arsenic? The symptoms attending the taking of arsenic are, in about a quarter of an hour, sickness at stomach, succeeded by vomiting, purging, burning pain in the bowels, heat and thirst, pains and cramps in the legs and thighs, syncope, and death. When the body is examined, the intestines appear inflamed and corroded; nay, some ulcerations appear about the anus even before death. But we must take care not to be deceived by erosions of the stomach occasioned by the gastric juice, which has a power of dissolving the stomach after death. The difference is, that the arsenic occasions inflammation and blackness, whereas none appears in the other case. If the person escapes, he is in danger of being afflicted by marasmus, paralytic affections of the limbs, great debility, &c.

"The second question generally asked is, Whether any arsenic has been found in the intestines? The method of discovering this is as follows. The contents of the stomach and intestines should be taken out and washed in water; and any powder it contains suffered to separate. If any arsenic be mixed with it, it will fall to the bottom, and must then be examined by the following methods.

"1. By laying it on a red hot iron. If it be arsenic, it will evaporate, without melting, in a thick white vapour; and this may be shown by the 40th part of a grain.

"2. We may mix some of it with charcoal; in which state, if it be arsenic, it will emit an odour very like garlic; but this will not be perceived unless it be mixed with charcoal or some inflammable matter.

"3. We may inclose the powder with some charcoal, between two polished bits of copper, the edges of which are moistened with a lute made of two parts of fine sand and one of pipe-clay. The plates being then bound together with a wire, and the whole made red hot, the arsenical powder will thus be metallized, and, penetrating the copper, a blackish skin will first appear upon it; which being rubbed off, the parts which the arsenical vapour has touched will appear of a whitish or lead colour.

"4. We may metallize or reduce the arsenic in a glass tube by means of the black flux. This is easily done by mixing two or three parts of the flux with one of the powder. This mixture being put into a small glass tube, and a heat applied sufficient for volatalizing the arsenic, the greatest part of it will be metallized. One end of the tube is to be left open at first, and then stopped with lint or wool; the other made red hot; and if the tube be then broken, the arsenic is found metallized. One grain of arsenic will be sufficient for all those experiments."

The first symptoms which ensue on the taking of arsenic show that it is of a highly inflammatory, caustic, and corrosive nature with regard to the system in general, and the intestines in particular: the pulse becomes extremely weak and irritable, and this is attended with a kind of paralytic affection of the limbs, marasmus, &c. Milk and oil have been recommended as antidotes; but the milk may curdle, and the oil will not mix with the fluids in the intestines. It is therefore advisable, when the physician is called to a patient who has swallowed arsenic, to make use of mucilages. A friend of Dr Black's, who had no mucilage at hand, thought of the whites of eggs, and succeeded. After the violence of the first attack is over, a milk diet, opiates, &c. are proper; and some time after, electricity has been found of great service. Some have advised to exhibit hepar sulphuris, as already noticed: but this is founded, not on experience, but theory; and it cannot be supposed that such a quantity can enter the system as will be sufficient for neutralizing the arsenic, and converting it into orpiment, which is the design of exhibiting it.

Edinburgh New Dispensatory.

The following account of the use of arsenic in medicine is given by Dr Duncan. "Notwithstanding, however, the very violent effects of arsenic, it has been employed in the cure of diseases, both as applied externally and as taken internally. Externally, white arsenic has been chiefly employed in cases of cancer; and as used in this way, it is supposed that its good effects depend on its acting as a peculiar corrosive: and it is imagined, that arsenic is the basis of a remedy long celebrated in cancer, which, however, is still kept a secret by a family of the name of *Plunket* in Ireland. According to the best conjectures, their application consists of the powder of some vegetables, particularly the ranunculus flammeus and cotula fœtida, with a considerable proportion of arsenic and flower of sulphur intimately mixed together. This powder, made into a paste with the white of an egg, is applied to the cancerous part which it is intended to corrode; and being covered with a piece of thin bladder, smeared also with the white of an egg, it is suffered to lie on from 24 to 48 hours; and afterwards the eschar is to be treated with softening digestive, as in other cases.

"Arsenic, in substance, to the extent of an eight of a grain for a dose, combined with a little of the flowers of sulphur, has been said to be employed internally in some very obstinate cases of cutaneous diseases, and with the best effect. But of this we have no experience.

"Of all the diseases in which white arsenic has been used internally, there is no one in which it has been so frequently and so successfully employed as in the cure of intermittent fevers. It has long been used in Lincolnshire, and some other of the fenny countries, under the name of the *arsenic drop*, prepared in different ways: And it is conjectured, that an article, which has had a very extensive sale, under the title of the *tasteless ague-drop*, the form of preparing which, however, is still kept a secret, is nothing else but a solution of arsenic. But whether this be the case or not, we have now the most satisfactory information concerning this article in the "Medical Reports, of the effects of Arsenic in the cure of agues, remitting fevers, and periodic headachs," by Dr Fowler of Stafford. He directs, that 64 grains of arsenic, reduced to a very fine powder, and mixed with as much fixed vegetable alkaline salt, should be added to half a pound of distilled water in a florence flask; that it should be then placed in a sand-heat,

heat, and gently boiled till the arsenic be completely dissolved; that after the solution is cold, half an ounce of compound spirit of lavender be added to it, and as much distilled water as to make the whole solution amount to a pound. This solution is taken in doses, regulated according to the age, strength, and other circumstances of the patient, from two to twelve drops, once, twice, or oftener in the course of the day. And in the diseases mentioned above, particularly in intermittents, it has been found to be a safe and very efficacious remedy, both by Dr Fowler and by other practitioners: but in some instances, even when given in very small doses, we have found it excite violent vomiting. But besides this, it has also been alleged by some, that those cured of intermittents by arsenic are very liable to become phthisical. If arsenic shall ever be extensively employed internally, it will probably be most certain and most safe in its operation when brought to the state of a salt readily soluble in water."

15 Other uses of arsenic.

With regard to its other uses he expresses himself thus: "Philosophers are wont to evince the extraordinary porosity of bodies, and the wonderful subtilty of vapours, by a sympathetic ink made with orpiment and lime*; for writing made with vinegar of litharge, by itself invisible, exposed to the vapour of this liquor becomes in a few minutes brown, even though a great many folds of paper be interposed.

* See *Sympathetic* INK.

16 Of the adulteration of wines.

"Wines naturally acid, or grown so by age, still continue to be edulcorated by lead, notwithstanding the punishments attending the detection of this fraud: it is therefore of great consequence to be in possession of an easy method of discovering such a sophistication. For this purpose a probatory liquor has been recommended, composed of caustic fixed alkali and orpiment; which instantly throws down a black or dark brown precipitate in consequence of the union of the sulphur of the orpiment with the metal. The same effect will take place on the addition of common hepar sulphuris: but methods have been contrived of eluding this proof. If a small quantity of chalk be contained in the wine, the saline hepar does not produce the intended effect; for the falling of the white calcareous earth diminishes the blackness. The other probatory liquor is also rendered ineffectual by a large quantity of tartar; because the tartareous acid, uniting with the lime, forms a kind of selenite, which in like manner diminishes the blackness.

17 Arsenic in composition with metals, &c.

"Arsenic sometimes enters metallic compositions, especially copper and tin; but it were much to be wished that such compositions were banished, at least from the kitchen. Shot made of lead is sometimes hardened by orpiment.

"Regulus of arsenic enters into the composition of Meuder's phosphorus. The power of the calx in vitrification was long ago known to Geber; and it is frequently employed in glass-houses, either for facilitating fusion, for acquiring a certain degree of opacity, or finally for carrying off phlogiston. The method in which mountain-crystals, placed over orpiment, white arsenic, crude antimony, and sal ammoniac, mixed in a crucible, are tinged by means of heat, is described by Neri, and upon trial is found to be true. I have thus obtained these crystals beautifully marked with red, yellow, and opal spots; but at the same time cracked, which could scarcely be avoided.

18 In painting

"In painting, too, the artists sometimes employ arsenic. Painters in oil frequently use both orpiment and realgar; and it is probable that wood covered with a pigment mixed with white arsenic would not be spoiled by worms. A most beautiful green pigment may be precipitated from blue vitriol by means of white arsenic dissolved in water, together with vegetable alkali. This prepared either with water or oil, affords a colour which suffers no change in many years. The playthings of children however, should not be painted with this or any other preparation of arsenic, on account of their custom of putting every thing into their mouths."

Arsenic is also used in dying, and the yellow combination of it with sulphur has the property of readily dissolving indigo; for which purpose it is used in cloth-printing. It lets it fall again, however, on exposure to the air; and therefore can be employed only in pencil-colours, where a large quantity is laid on at once. The neutral arsenical salt is used in some manufactures in France; but for what purposes is not known.

ARSENIUS, a deacon of the Roman church, of great learning and piety. He was pitched upon by the pope to go to the emperor Theodosius, as tutor to his son Arcadius. Arsenius arrived at Constantinople in the year 383. The emperor happening one day to go into the room where Arsenius was instructing Arcadius, his son was seated and the preceptor standing; at this he was exceedingly displeased, took from his son the imperial ornaments, made Arsenius sit in his place, and ordered Arcadius for the future to receive his lessons standing uncovered. Arcadius, however, profited but little by his tutor's instructions, for some time after he formed a design of dispatching him. The officer to whom Arcadius had applied for this purpose, divulged the affair to Arsenius, who retired to the desarts of Scete, where he passed many years in the exercises of the most strict and fervent devotion. He died there, at 95 years of age.

ARSHOT, a town of the Austrian Netherlands, situated about 14 miles east of the city of Mechlin, in E. Long. 4. 45. N. Lat. 51. 5.

ARSINOE (anc. geog.), a town of Egypt, on the west side of the Arabian gulf, near its extremity, to the south of Heroopolis, (Strabo, Ptolemy); called *Cleopatris* by some. Another Arsinoe, a town of Cilicia, (Ptolemy); and the fifth of that name in Cilicia, (Stephanus); with a road or station for ships, (Strabo). A third Arsinoe, in the south of Cyprus, with a port between Citium and Salamis, (Strabo). A fourth, an inland town of Cyprus, called *Marium* formerly, (Stephanus). A fifth in the north of Cyprus, between Acamas and Soli, (Strabo); so called from Arsinoe, a queen of Egypt, Cyprus being in the hands of the Ptolemies. A sixth Arsinoe, a maritime town of Cyrene, formerly called *Teuchira*. A seventh Arsinoe, in the Nomos Arsinoites, to the west of the Heracleotes, on the western bank of the Nile, formerly called *Crocodilorum Urbs*, (Strabo); the name *Arsinoe* continued under Adrian, (Coin). Ptolemy calls this Arsinoe an inland metropolis, and therefore at some distance from the Nile, with a port called *Ptolemais*. An eighth Arsinoe, a maritime town of Lycia; so called by Ptolemy Philadelphus, after the name of his consort, which did not hold long, it afterwards recovering its ancient name

Patara,

Patara, (Strabo). A ninth, a town of the Troglodytæ, near the mouth of the Arabian Gulf, which towards Ethiopia is terminated by a promontory called *Dire*, (Ptolemy). This Arsinoe is called *Berenice*, and the third of that name in this quarter, with the distinction *Epidires*; because situate on a neck of land running a great way out into the sea.

ARSIS *and* THESIS, in music, is a term applied to compositions in which one part rises and the other falls.

ARSMART, in botany. See PERSICARIA.

ARSON, in English law, is the malicious and wilful burning of the house or out-house of another man; which is felony at common law.

This is an offence of very great malignity, and much more pernicious to the public than simple theft: because, first, it is an offence against that right of habitation, which is acquired by the law of nature as well as by the laws of society; next, because of the terror and confusion that necessarily attend it; and, lastly, because in simple theft the thing stolen only changes its master, but still remains *in esse* for the benefit of the public; whereas by burning the very substance is absolutely destroyed. It is also frequently more destructive than murder itself, of which too it is often the cause: since murder, atrocious as it is, seldom extends beyond the felonious act designed; whereas fire too frequently involves in the common calamity persons unknown to the incendiary, and not intended to be hurt by him, and friends as well as enemies.

ARSURA, in ancient customs, a term used for the melting of gold or silver, either to refine them, or to examine their value.—The method of doing this is explained at large in the Black Book of the Exchequer, ascribed to Gervaise, in the chapter *De Officio Militis Argentarii*, being in those days of great use, on account of the various places and different manners in which the king's money was paid.

ARSURA is also used for the loss or diminution of the metal in the trial. In this sense, a pound was said *tot ardere denarios*, to lose so many penny-weights.

ARSURA is also used for the dust and sweepings of silver-smiths, and others, who work in silver, melted down.

ART is defined by Lord Bacon, a proper disposal of the things of nature by human thought and experience, so as to answer the several purposes of mankind; in which sense *art* stands opposed to *nature*.

Art is principally used for a system of rules serving to facilitate the performance of certain actions; in which sense it stands opposed to *science*, or a system of speculative principles.

Arts are commonly divided into *useful* or *mechanic*, *liberal* or *polite*. The former are those wherein the *hand* and *body* are more concerned than the mind: of which kind are most of those which furnish us with the *necessaries* of life, and are popularly known by the name of *trades*; as baking, brewing, carpentry, smithery, weaving, &c.—The latter are such as depend more on the labour of the mind than that of the hand; they are the produce of the *imagination*, their essence consists in *expression*, and their end is *pleasure*. Of this kind are poetry, painting, music, &c.

1 Origin

Progress of the Arts. Some useful arts must be nearly coeval with the human race; for food, cloathing, and habitation, even in their original simplicity, require some art. Many other arts are of such antiquity as to place the inventors beyond the reach of tradition. Several have gradually crept into existence without an inventor. The busy mind, however, accustomed to a beginning in things, cannot rest till it finds or imagines a beginning to every art. The most probable conjectures of this nature the reader may see in the historical introduction to the different articles.

and progress of useful arts. [Kames's Sketches, Sk. V.]

In all countries where the people are barbarous and illiterate, the progress of arts is extremely slow. It is vouched by an old French poem, that the virtues of the loadstone were known in France before anno 1180. The mariner's compass was exhibited at Venice anno 1260, by Paulus Venetus, as his own invention. John Goya of Amalphi was the first who, many years afterward, used it in navigation; and also passed for being the inventor. Though it was used in China for navigation long before it was known in Europe, yet to this day it is not so perfect as in Europe. Instead of suspending it in order to make it act freely, it is placed upon a bed of sand, by which every motion of the ship disturbs its operation. Hand-mills, termed *querns*, were early used for grinding corn; and when corn came to be raised in greater quantity, horse-mills succeeded. Water-mills for grinding corn are described by Vitruvius. Wind-mills were known in Greece and in Arabia as early as the seventh century; and yet no mention is made of them in Italy till the fourteenth. That they were not known in England in the reign of Henry VIII. appears from a houshold book of an Earl of Northumberland, cotemporary with that king, stating an allowance for three mill-horses, "two to draw in the mill, and one to carry stuff to the mill and fro." Water-mills for corn must in England have been of a later date. The ancients had mirror-glasses, and employed glass to imitate crystal vases and goblets; yet they never thought of using it in windows. In the 13th century, the Venetians were the only people who had the art of making crystal-glass for mirrors. A clock that strikes the hours was unknown in Europe till the end of the 12th century. And hence the custom of employing men to proclaim the hours during night; which to this day continues in Germany, Flanders and England. Galileo was the first who conceived an idea that a pendulum might be useful for measuring time; and Huygens was the first who put the idea in execution, by making a pendulum clock. Hook, in the year 1660, invented a spiral spring for a watch, though a watch was far from being a new invention. Paper was made no earlier than the 14th century; and the invention of printing was a century later. Silk manufactures were long established in Greece before silkworms were introduced there. The manufacturers were provided with raw silk from Persia: but that commerce being frequently interrupted by war, two monks in the reign of Justinian, brought eggs of the silkworm from Hindostan, and taught their countrymen the method of managing them.—The art of reading made a very slow progress. To encourage that art in England, the capital punishment for murder was remitted if the criminal could but read, which in law-language is termed *benefit of clergy*. One would imagine that the art must have made a very rapid progress when so greatly favoured: but there is a signal proof of of the contrary; for so small an edition of the Bible as 600 copies, translated into English in the reign of Henry VIII. was not wholly sold off in three years. The people of England must have been profoundly ignorant in Queen Elizabeth's time, when a forged clause added to the 20th article of the English creed passed unnoticed till about 50 years ago.

The discoveries of the Portuguese in the west coast of Africa is a remarkable instance of the slow progress of arts. In the beginning of the 15th century, they were totally ignorant of that coast beyond Cape Non, 28 deg. north latitude. In 1410, the celebrated Prince Henry of Portugal fitted out a fleet for discoveries, which proceeded along the coast to Cape Bojadore in 26 deg. but had not courage to double it. In 1418, Tristan Vaz discovered the island Porto Santo; and the year after, the island Maderia was discovered. In 1439, a Portuguese captain doubled Cape Bojadore; and the next year the Portuguese reached Cape Blanco, lat. 20 deg. In 1446, Nuna Tristan doubled Cape Verd, lat. 14. 40. In 1448, Don Gonzallo Vallo took possession of the Azores. In 1449, the islands of Cape Verd were discovered for Don Henry. In 1471, Pedro d'Escovar discovered the island St Thomas and Prince's Island. In 1484, Diego Cam discovered the kingdom of Congo. In 1486, Bartholomew Diaz, employed by John II. of Portugal, doubled the Cape of Good Hope, which he called *Cabo Tormentoso*, from the tempestuous weather he found in the passage.

2 Causes which advance the progress of art.

The exertion of national spirit upon any particular art, promotes activity to prosecute other arts. The Romans, by constant study, came to excel in the art of war, which led them naturally to improve upon other arts. Having, in the progress of society, acquired some degree of taste and polish, a talent for writing broke forth. Nevius composed in verse seven books of the Punic war; besides comedies, replete with bitter raillery against the nobility. Ennius wrote annals, and an epic poem. Lucius Andronicus was the father of dramatic poetry in Rome. Pacuvius wrote tragedies. Plautus and Terence wrote comedies. Lucilius composed satires, which Cicero esteems to be slight and void of erudition. Fabius Pictor, Cincius Alimentus, Piso Frugi, Valerius Antias, and Cato, were rather annalists than historians, confining themselves to naked facts, ranged in order of time. The genius of the Romans for the fine arts was much inflamed by Greek learning, when free intercourse between the two nations was opened. Many of those who made the greatest figure in the Roman state commenced authors; Cæsar, Cicero, &c. Sylla composed memoirs of his own transactions, a work much esteemed even in the days of Plutarch.

The progress of art seldom fails to be rapid, when a people happen to be roused out of a torpid state by some fortunate change of circumstances. Prosperity, contrasted with former abasement, gives to the mind a spring, which is vigorously exerted in every new pursuit. The Athenians made but a mean figure under the tyranny of Pisistratus; but upon regaining freedom and independence, they were converted into heroes. Miletus, a Greek city of Ionia, being destroyed by the king of Persia, and the inhabitants made slaves, the Athenians, deeply affected with the misery of their brethren, boldly attacked the king in his own dominions, and burnt the city of Sardis. In less than 10 years after, they gained a signal victory at Marathon; and, under Themistocles, made head against that prodigious army with which Xerxes threatened utter ruin to Greece. Such prosperity produced its usual effect: arts flourished with arms, and Athens became the chief theatre for sciences as well as for fine arts. The reign of Augustus Cæsar, which put an end to the rancour of civil war, and restored peace to Rome with the comforts of society, proved an auspicious æra for literature; and produced a cloud of Latin historians, poets, and philosophers, to whom the moderns are indebted for their taste and talents. One who makes a figure rouses emulation in all: one catches fire from another, and the national spirit is every where triumphant: classical works are composed, and useful discoveries made in every art and science. With regard to Rome, it is true, that the Roman government under Augustus was in effect despotic: but despotism, in that single instance, made no obstruction to literature, it having been the politic of that reign to hide power as much as possible. A similar revolution happened in Tuscany about three centuries ago. That country having been divided into a number of small republics, the people, excited by mutual hatred between small nations in close neighbourhood, became ferocious and bloody, flaming with revenge for the slightest offence. These republics being united under the Great Duke of Tuscany, enjoyed the sweets of peace in a mild government. That comfortable revolution, which made the deeper impression by a retrospect to recent calamities, roused the national spirit, and produced ardent application to arts and literature. The restoration of the royal family in Englannd, which put an end to a cruel and envenomed civil war, promoted improvements of every kind: arts and industry made a rapid progress among the people, though left to themselves by a weak and fluctuating administration. Had the nation, upon that favourable turn of fortune, been blessed with a succession of able and virtuous princes, to what a height might not arts and sciences have been carried! In Scotland, a favourable period for improvement was the reign of the first Robert, after shaking off the English yoke; but the domineering spirit of the feudal system rendered abortive every-attempt. The restoration of the royal family mentioned above, animated the legislature of Scotland to promote manufactures of various kinds: but in vain; for the union of the two crowns had introduced despotism into Scotland, which sunk the genius of the people, and rendered them heartless and indolent. Liberty, indeed, and many other advantages, were procured to them by the union of the two kingdoms; but the salutary effects were long suspended by mutual enmity, such as commonly subsists between neighbouring nations. Enmity wore out gradually, and the eyes of the Scots were opened to the advantages of their present condition; the national spirit was roused to emulate and to excel; talents were exerted, hitherto latent; and Scotland at present makes a figure in arts and sciences above what it ever made while an independent kingdom.

Another cause of activity and animation, is the being engaged in some important action of doubtful event; a struggle for liberty, the resisting a potent invader, or the like. Greece, divided into small states frequently at war with each other, advanced literature and

Arts.

and the fine arts to unrivalled perfection. The Corsicans, while engaged in a perilours war for defence of their liberties exerted a vigorous national spirit; they founded a university for arts and sciences, a public library and a public bank. After a long stupor during the dark ages of Christianity, arts and literature revived among the turbulent states of Italy. The royal society in London, and the academy of sciences in Paris, were both of them instituted after civil wars that had animated the people and roused their activity.

As the progress of arts and sciences toward perfection is greatly promoted by emulation, nothing is more fatal to an art or science than to remove that spur, as where some extraordinary genius appears who soars above rivalship. Mathematics seem to be declining in Britain: the great Newton having surpassed all the ancients, has not left to the moderns even the faintest hope of equalling him; and what man will enter the lists who despairs of victory?

In a country thinly peopled, where even necessary arts want hands, it is common to see one person exercising more arts than one: in several parts of Scotland, one man serves as physician, surgeon, and apothecary. In every populous country, even simple arts are split into parts, and each part has an artist appropropriated to it. In the large towns of ancient Egypt, a physician was confined to a single disease. In mechanic arts that method is excellent. As a hand confined to a single operation becomes both expert and expeditious, a mechanic art is perfected by having its different operations distributed among the greatest number of hands; many hands are employed in making a watch, and a still greater number in manufacturing a web of woollen cloth. Various arts or operations carried on by the same man, envigorate his mind, because they exercise different faculties; and as he cannot be equally expert in every art or operation, he is frequently reduced to supply want of skill by thought and invention. Constant application, on the contrary, to a single operation, confines the mind to a single object, and excludes all thought and invention: in such a train of life, the operator becomes dull and stupid, like a beast of burden. The difference is visible in the manners of the people: in a country where, from want of hands, several occupations must be carried on by the same person, the people are knowing and conversable: in a populous country, were manufactures flourish, they are ignorant and unsociable. The same effect is equally visible in countries where an art or manufacture is confined to a certain class of men. It is visible in Indostan, where the people are divided into casts, which never mix even by marriage, and where every man follows his father's trade. The Dutch lint-boors are a similar instance; the same families carry on the trade from generation to generation; and are accordingly ignorant and brutish even beyond other Dutch peasants. The inhabitants of Buckhaven, a sea-port in the county of Fife, in Scotland, were originally a colony of foreigners, invited to teach the people the art of fishing. They continue fishers to this day, marry among themselves, have little intercourse with their neighbours, and are dull and stupid to a proverb.

3
Progress of the *fine arts.*

Useful arts paved the way to fine arts. Men upon whom the former had bestowed every convenience, turned their thoughts to the latter. Beauty was studied in objects of sight; and men of taste attached themselves to the fine arts, which multiplied their enjoyments and improved their benevolence. Sculpture and painting made an early figure in Greece; which afforded plenty of beautiful originals to be copied in these imitative arts. Statuary, a more simple imitation than painting, was sooner brought to perfection: the statue of Jupiter by Phidias, and of Juno by Polycletes, though the admiration of all the world, were executed long before the art of light and shade was known. Apollodorus, and Zeuxis his disciple, who flourished in the 15th Olympiad, were the first who figured in that art. Another cause concurred to advance statuary before painting in Greece, viz. a great demand for statues of the gods. Architecture, as a fine art, made a slower progress. Proportions, upon which its elegance chiefly depends, cannot be accurately ascertained, but by an infinity of trials in great buildings: a model cannot be relied on; for a large and a small building, even of the same form, require different proportions.

4
Literary composition.

From the fine arts mentioned, we proceed to literature. It is agreed, among all antiquaries, that the first writings were in verse, and that writing in prose was of a much latter date. The first Greek who wrote in prose was Pherecides Syrus: the first Roman was Appius Cæcus, who composed a declamation against Pyrrhus. The four books of the Chatah Bhade, which is the sacred book of Hindostan, are composed in verse stanzas; and the Arabian compositions in prose followed long after those in verse. To account for that singular fact, many learned pens have been employed; but without success. By some it has been urged, that as memory is the only record of events where writing is unknown, history originally was composed in verse for the sake of memory. This is not satisfactory. To undertake the painful task of composing in verse, merely for the sake of memory, would require more foresight than ever was exerted by a barbarian: not to mention that other means were used for preserving the memory of remarkable events; a heap of stones, a pillar, or other object that catches the eye. The account given by Longinus is more ingenious. In a fragment of his treatise on verse, the only part that remains, he observes, "that measure or verse belongs to poetry, because poetry represents the various passions with their language; for which reason the ancients, in their ordinary discourse, delivered their thoughts in verse rather than in prose." Longinus thought, that anciently men were more exposed to accidents and dangers, than when they were protected by good government and by fortified cities. But he seems not to have adverted, that fear and grief, inspired by dangers and misfortunes, are better suited to humble prose than to elevated verse. It may be added, that however natural poetical diction may be when one is animated with any vivid passion, it is not supposable that the ancients never wrote nor spoke but when excited by passion. Their history, their laws, their covenants, were certainly not composed in that tone of mind.

An important article in the progress of the fine arts, which writers have not sufficiently attended to, will perhaps explain this mystery. The article is the profession

Art. fession of a bard, which sprung up in early times, before writing was known †, and died away gradually as writing turned more and more common ‡.

† See the article *Writing*.
‡ See *Bard*.

The songs of the bards, being universal favourites, were certainly the first compositions that writing was employed upon: they would be carefully collected by the most skilful writers, in order to preserve them in perpetual remembrance. The following part of the progress is obvious. People acquainted with no written compositions, but what were in verse, composed in verse their laws, their religious ceremonies, and every memorable transaction that was intended to be preserved in memory by writing. But when subjects of writing multiplied, and became more and more involved; when people began to reason, to teach, and to harangue; they were obliged to descend to humble prose: for to confine a writer or speaker to verse in handling subjects of that nature, would be a burden unsupportable.

5 History.

The prose compositions of early historians are all of them dramatic. A writer destitute of art is naturally prompted to relate facts as he saw them performed: he introduces his personages as speaking and conferring; and he himself relates what was acted, and not spoke. The historical books of the Old Testament are composed in that mode; and so addicted to the dramatic are the authors of those books, that they frequently introduce God himself into the dialogue. At the same time, the simplicity of that mode is happily suited to the poverty of every language in its early periods. The dramatic mode has a delicious effect in expressing sentiment, and every thing that is simple and tender. Read, as an instance of a low incident becoming, by that means, not a little interesting, Ruth i. 8. to iv. 16.

The dramatic mode is far from pleasing so much in relating bare historical facts. Read, as an example, the story of Adonijah in 1. Kings i. 11.—49.

In that passage there are frequent repetitions; not however by the same person, but by different persons who have occasion in the course of the story to say the same things; which is natural in the dramatic mode, where things are represented precisely as they were transacted. In that view, Homer's repetitions are a beauty, not a blemish; for they are confined to the dramatic part, and never occur in the narrative.

But the dramatic mode of composition, however pleasing, is tedious and intolerable in a long history. In the progress of society new appetites and new passions arise; men come to be involved with each other in various connections; incidents and events multiply, and history becomes intricate by an endless variety of circumstances. Dialogue accordingly is more sparingly used, and in history plain narration is mixed with it. Narration is as it were the ground-work; and dialogue is raised upon it, like flowers in embroidery. Homer is admitted by all to be the great master in that mode of composition.

The narrative mode came in time so to prevail, that in a long chain of history, the writer commonly leaves off dialogue altogether. Early writers of that kind appear to have very little judgment in distinguishing capital facts from minute circumstances, such as can be supplied by the reader without being mentioned. The history of the Trojan war by Dares Phrygius is a curious instance of that cold and creeping manner of composition. The Roman histories before the time of Cicero are chronicles merely. Cato, Fabius Pictor, and Piso, confined themselves to naked facts. In the Augustæ Historiæ Scriptores we find nothing but a jejune narrative of facts, commonly of very little moment, concerning a degenerate people, without a single incident that can rouse the imagination or exercise the judgment. The monkish histories are all of them composed in the same manner.

The dry narrative manner being very little interesting or agreeable, a taste for embellishment prompted some writers to be copious and verbose. Saxo-Grammaticus, who in the 12th century composed in Latin a history of Denmark, surprisingly pure at that early period, is extremely verbose and full of tautologies. Such a style, at any rate unpleasant, is intolerable in a modern tongue, before it is enriched with a stock of phrases for expressing aptly the great variety of incidents that enter into history.

The perfection of historical composition, which writers at last attain to after wandering through various imperfect modes, is a relation of interesting facts, connected with their motives and consequences. An history of that kind is truly a chain of causes and effects.

The history of Thucydides, and still more that of Tacitus, are shining instances of that mode.

6 Eloquence.

Eloquence was of a later date than the art of literary composition: for till the latter was improved, there were no models for studying the former. Cicero's oration for Roscius is composed in a style diffuse and highly ornamented; which, says Plutarch, was universally approved, because at that time the style in Asia, introduced into Rome with its luxury, was in high vogue. But Cicero, in a journey to Greece, where he leisurely studied Greek authors, was taught to prune off superfluities, and to purify his style, which he did to a high degree of refinement. He introduced into his native tongue a sweetness, a grace, a majesty, that surprised the world, and even the Romans themselves. Cicero observes with great regret, that if ambition for power had not drawn Julius Cæsar from the bar to command legions, he would have become the most complete orator in the world. So partial are men to the profession in which they excel. Eloquence triumphs in a popular assembly, makes some figure in a court of law composed of many judges, very little where there is but a single judge, and none at all in a despotic government. Eloquence flourished in the republics of Athens and of Rome; and makes some figure at present in a British house of Commons.

7 Tragedy.

The Greek stage has been justly admired among all polite nations. The tragedies of Sophocles and Euripides in particular are by all critics held to be perfect in their kind, excellent models for imitation, but far above rivalship. If the Greek stage was so early brought to maturity, it is a phenomenon not a little singular in the progress of arts. The Greek tragedy made a rapid progress from Thespis to Sophocles and Euripides, whose compositions are wonderful productions of genius, considering that the Greeks at that period were but beginning to emerge from roughness and barbarity into a taste for literature. The compositions of Eschylus, Sophocles, and Euripides, must

Art. have been highly relished among people who had no idea of any thing more perfect. We judge by comparison, and every work is held to be perfect that has no rival. It ought at the same time to be kept in view, that it was not the dialogue which chiefly enchanted the Athenians, nor variety in the passions represented, nor perfection in the actors; but machinery and pompous decoration, joined with exquisite music. That these particulars were carried to the greatest height, we may with certainty conclude from the extravagant sums bestowed on them: the exhibiting a single tragedy was more expensive to the Athenians than their fleet or their army in any single campaign.

One would imagine, however, that these compositions were too simple to enchant for ever; as variety in action, sentiment, and passion is requisite, without which the stage will not continue long a favourite entertainment: and yet we find not a single improvement attempted after the days of Sophocles and Euripides. The manner of performance, indeed, prevented absolutely any improvement. A fluctuation of passion and refined sentiments would have made no figure on the Grecian stage. Imagine the discording scene between Brutus and Cassius in Julius Cæsar to be there exhibited, or the handkerchief in the Moor of Venice: how slight would be their effect, when pronounced in a mask, and through a pipe? The workings of nature upon the countenance, and the flections of voice expressive of various feelings, so deeply affecting in modern representation, would have been entirely lost. If a great genius had arisen with talents for composing a pathetic tragedy in perfection, he would have made no figure in Greece. An edifice must have been erected of a moderate size: new actors must have been trained to act with a bare face, and to pronounce in their own voice. And after all, their remained a greater miracle still to be performed, viz. a total reformation of taste in the people of Athens. In one word, the simplicity of the Greek tragedy was suited to the manner of acting; and that manner excluded all improvements.

8 Comedy.

With respect to comedy, it does not appear that the Greek comedy surpassed the tragedy in its progress toward perfection. Horace mentions three stages of Greek comedy. The first well suited to the rough and course manners of the Greeks, when Eupolis, Cratinus, and Aristophanes, wrote. These authors were not ashamed to represent on the stage real persons, not even disguising their names: of which we have a striking instance in a comedy of Aristophanes, called *the Clouds*, where Socrates is introduced, and most contemptuously treated. This sort of comedy, sparing neither gods nor men, was restrained by the magistrates of Athens, so far as to prohibit persons to be named on the stage. This led writers to do what is done at present: the characters and manners of known persons were painted so much to the life, that there could be no mistake: and the satire was indeed heightened by this regulation, as it was an additional pleasure to find out the names that were meant in the representation. This was termed the *middle comedy*. But as there still remained too great scope for obloquy and licentiousness, a law was made prohibiting real events or incidents to be introduced upon the stage. This law happily banished satire against individuals, and confined it to manners and customs in general. Obedient to this law are the comedies of Menander, Philemon, and Diphilus, who flourished about 300 years before the Christian æra. And this is termed the *third stage* of Greek comedy. The comedies of Aristophanes which still remain, err not less against taste than against decency. But the Greek comedy is supposed to have been considerably refined by Menander and his cotemporaries. Their works, however, were far from perfection, if we can draw any conjecture from their imitator Plautus, who wrote about a century later. Plautus was a writer of genius; and it may be reasonably supposed that his copies did not fall much short of the originals, at least in matters that can be faithfully copied: and he shows very little art, either in his compositions or in the conduct of his pieces. With respect to the former, his plots are wondrous simple, very little varied, and very little interesting. The subject of almost every piece is a young man in love with a music-girl, desiring to purchase her from the procurer, and employing a favourite slave to cheat his father out of the price; and the different ways of accomplishing the cheat is all the variety we find. In some few of his comedies the story rises to a higher tone, the music-girl being discovered to be the daughter of a freeman, which removes every obstruction to a marriage between her and her lover. In the conduct of his pieces there is a miserable defect of art. Instead of unfolding the subject in the progress of the action, as is done by Terence, and by every modern writer, Plautus introduces a person for no other end but to explain the story to the audience. In one of his comedies, a household-god is so obliging as not only to unfold the subject, but to relate before-hand every particular that is to be represented, not excepting the catastrophe.

The Roman theatre, from the time of Plautus to that of Terence, made a rapid progress. Aristotle defines comedy to be "an imitation of light and trivial subjects, provoking laughter." The comedies of Plautus correspond accurately to that definition: those of Terence rise to a higher tone.

Nothing is more evident than the superiority of Terence above Plautus in the art of writing; and, considering that Terence is a later writer, nothing would appear more natural, if they did not copy the same originals. It may be owing to genius that Terence excelled in purity of language and propriety of dialogue; but how account for his superiority over Plautus in the construction and conduct of a play? It will not certainly be thought, that Plautus would imitate the worst constructed plays, leaving the best to those who should come after him. This difficulty does not seem to have occurred to any of the commentators. Had the works of Menander and of his cotemporaries been preserved, they probably would have explained the mystery; which for want of that light will probably remain a mystery for ever.

Homer has for more than 2000 years been held the prince of poets. Such perfection in an author who flourished when arts were far short of maturity, is truly wonderful. The nations engaged in the Trojan war are described by him as in a progress from the shepherd-state to that of agriculture. Frequent mention is made in the Iliad of the most eminent men being shepherds. Andromache, in particular, mentions seven of her brethren who were slain by Achilles as they tended their father's 9 Epopee.

father's flocks and herds. In that state, garments of woollen cloth were used; but the skins of beasts, the original clothing, were still worn as an upper garment: every chief in the Iliad appears in that dress. Such indeed was the simplicity of this early period, that a black ewe was promised by each chief to the man who would undertake to be a spy. In times of such simplicity, literature could not be far advanced; and it is a great doubt, whether there was at that time a single poem of the epic kind for Homer to imitate or improve upon. Homer is undoubtedly a wonderful genius, perhaps the greatest that ever existed; his fire, and the boldness of his conceptions, are inimitable. But in that early age, it would fall little short of a real miracle, to find such ripeness of judgment, and correctness of execution, as in modern writers are the fruits of long experience and progressive improvements during the course of many centuries. Accordingly, that Homer is far from being so ripe, or so correct, cannot escape the observation of any reader of taste and discernment. One striking particular is, his digressions without end, which draw our attention from the principal subject. Diomedes, for instance, meeting with Glaucus in the field of battle, and doubting, from his majestic air, whether he might not be an immortal, inquires who he was, declaring that he would not fight with a god. Glaucus lays hold of this very slight opportunity, in the very heat of action, to give a long history of his family. In the mean time, the reader's patience is put to a trial, and his ardour cools. Again, Agamemnon desiring advice how to resist the Trojans, Diomedes springs forward; but, before he offers advice, gives the history of all his progenitors, and of their characters, in a long train. And, after all, what was the sage advice that required such a preface? It was, that Agamemnon should exhort the Greeks to fight bravely. At any rate, was Diomedes so little known, as to make it proper to suspend the action at so critical a juncture, for a genealogical history? There is a third particular which justly merits censure; and that is, an endless number of minute circumstances, especially in the description of battles, where they are most improper. The capital beauty of an epic poem is, the selection of such incidents and circumstances as make a deep impression, keeping out of view every thing low or familiar. An account of a single battle employs the whole fifth book of the Iliad and a great part of the sixth: yet in the whole there is no general action; but unknown warriors whom we never heard of before, killed at a distance with an arrow or a javelin; and every wound described with anatomical accuracy. The whole seventeenth book is employed in the contest about the dead body of Patroclus, stuffed with minute circumstances, below the dignity of an epic poem. In such scenes the reader is fatigued with endless particulars; and has nothing to support him but the melody of Homer's versification.

10
Causes of the decline of the fine arts.

Having traced the progress of the fine arts toward maturity, in a summary way, the decline of these arts comes next in order. An art, in its progress toward maturity, is greatly promoted by emulation; and, after arriving at maturity, its downfal is not less promoted by it. It is difficult to judge of perfection but by comparison; and an artist, ambitious to outstrip his predecessors, cannot submit to be an imitator, but must strike out something new, which, in an art advanced to ripeness, seldom fails to be a degeneracy. This cause of the decline of the fine arts may be illustrated by various instances. The perfection of vocal music is to accompany passion, and to enforce sentiment. In ancient Greece, the province of music was well understood; which, being confined within its proper sphere, had an enchanting influence. Harmony at that time was very little cultivated, because it was of very little use; melody reaches the heart, and it is by it chiefly that a sentiment is enforced, or a passion soothed: harmony, on the contrary, reaches the ear only; and it is a matter of undoubted experience, that the most melodious airs admit but of very simple harmony. Artists, in later times, ignorant why harmony was so little regarded by the ancients, applied themselves seriously to its cultivation; and they have been wonderfully successful. But they have been successful at the expence of melody; which, in modern compositions, generally speaking, is lost amid the blaze of harmony. These compositions tickle the ear by the luxury of complicated sounds, but seldom make any impression on the heart. The Italian opera, in its form, resembles the Greek tragedy, from which it is evidently copied; but very little in substance. In the latter, music being made subservient to sentiment, the dialogue is nervous and sublime: in the former, the whole weight is laid on music; and the dialogue, devoid of sentiment, is weak and spiritless. Restless man knows no golden mean, but will be attempting innovations without end.—By the same ambition, architecture has visibly declined from its perfection. The Ionic was the favourite order when architecture was in its height of glory. The Corinthian order came next; which, in attempting greater perfection, has deviated from the true simplicity of nature: and the deviation is still greater in the Composite order. With respect to literary productions, the first essays of the Romans were very imperfect. We may judge of this from Plautus, whose compositions are abundantly rude, though much admired by his cotemporaries, being the best that existed at that time. The exalted spirit of the Romans hurried them on to the grand and beautiful; and literary productions of all kinds were in perfection when Augustus reigned. In attempting still greater perfection, the Roman compositions became a strange jumble of inconsistent parts: they were tumid and pompous; and, at the same time, full of antitheses, conceit, and tinsel wit. Every thing new in the fine arts pleases, though less perfect than what we are accustomed to; and, for that reason, such compositions were generally relished. We see not by what gradual steps writers, after the time of Augustus, deviated from the patterns that were before them; for no book of any moment after that time is preserved till we come down to Seneca, in whose works nature and simplicity give place to artificial thought and bastard wit. He was a great corrupter of the Roman taste; and after him nothing was relished but brilliant strokes of fancy, with very little regard to sentiment: even Virgil and Cicero made no figure in comparison. Lucan has a forced elevation of thought and style very difficult to be supported; and, accordingly, he sinks ofen into puerile reflections; witness his encomium on the river Po; which, says he, would equal the Danube, had it the

Art. ſame number of tributary ſtreams. Quintilian, a writer of true and claſſical taſte, who was protected and encouraged by Veſpaſian, attempted to ſtem the tide of falſe writing. His rhetoric is compoſed in an elegant ſtyle; and his obſervations contain every delicacy of the critical art. At the ſame time flouriſhed Tacitus, poſſeſſing a more extenſive knowledge of the nature of man than any other author, ancient or modern, if Shakeſpeare be not excepted. His ſtyle is original, conciſe, compact, and comprehenſive; and, in what is properly called his *hiſtory*, perfectly correct and beautiful. He has been imitated by ſeveral, but never equalled by any. Brutus is ſaid to be the laſt of the Romans for love of liberty: Quintilian and Tacitus may be ſaid to be the laſt of the Romans for literary genius. Pliny the Younger is no exception: his ſtyle is affected, turgid, and full of childiſh brilliancy. Seneca and Pliny are proper examples of writers who ſtudy ſhow more than ſubſtance, and who make ſenſe yield to ſound. The difference between theſe authors and thoſe of the Auguſtan age, reſembles the difference between Greek and Italian muſic. Muſic, among the Greeks, limited itſelf to the employment to which it is deſtined by nature, viz. to be the handmaid of ſenſe, to enforce, enliven, or ſweeten a ſentiment. In the Italian opera, the miſtreſs is degraded to be handmaid; and harmony triumphs, with very little regard to ſentiment.

Another great cauſe that precipitates the downfal of every fine art is deſpotiſm. The reaſon is obvious; and there is a diſmal example of it in Rome, particularly with regard to eloquence. We learn from a dialogue accounting for the corruption of the Roman eloquence, that in the decline of the art it became faſhionable to ſtuff harangues with impertinent poetical quotations, without any view but ornament merely; and this alſo was long faſhionable in France. It happened unluckily for the Romans, and for the world, that the fine arts were at their height in Rome, and not much upon the decline in Greece, when deſpotiſm put an end to the republic. Auguſtus, it is true, retarded their fall, particularly that of literature; it being the politic of his reign to hide deſpotiſm, and to give his government an air of freedom. His court was a ſchool of urbanity, where people of genius acquired that delicacy of taſte, that elevation of ſentiment, and that purity of expreſſion, which characteriſe the writers of his time. He honoured men of learning, admitted them to his table, and was bountiful to them. It would be painful to follow the decline of the fine arts in Rome to their total extirpation. The tyranny of Tiberius, and of ſubſequent emperors, broke at laſt the elevated and independent ſpirit of the brave Romans, reduced them to abject ſlavery, and left not a ſpark of genius. The ſcience of law is the only exception, as it flouriſhed even in the worſt of times: the Roman lawyers were a reſpectable body, and leſs the object of jealouſy than men of power and extenſive landed property. Among the Greeks alſo, a conquered people, the fine arts decayed; but not ſo rapidly as at Rome; the Greeks, farther removed from the ſeat of government, being leſs within the reach of a Roman tyrant. During their depreſſion, they were guilty of the moſt puerile conceits: witneſs verſes compoſed in the form of an ax, an egg, wings, and ſuch like. The ſtyle of Greek authors, in the reign of the emperor Adrian, is unequal, obſcure, ſtiff, and affected. Lucian is the only exception that may be made. Art.

We need ſcarce any other cauſe but deſpotiſm, to account for the decline of ſtatuary and painting in Greece. Theſe arts had arrived at their utmoſt perfection about the time of Alexander the Great; and from that time they declined gradually with the vigour of a free people; for Greece was now enſlaved by the Macedonian power. It may in general be obſerved, that when a nation becomes ſtationary in that degree of power which it acquires from its conſtitution and ſituation, the national ſpirit ſubſides, and men of talents become rare. It is ſtill worſe with a nation that is ſunk below its former power and pre-eminence; and worſt of all when it is reduced to ſlavery. Other cauſes concurred to accelerate the downfal of the arts mentioned. Greece, in the days of Alexander, was filled with ſtatues of excellent workmanſhip, and there being little demand for more, the later ſtatuaries were reduced to heads and buſts. At laſt the Romans put a total end both to ſtatuary and painting in Greece, by plundering it of its fineſt pieces; and the Greeks, expoſed to the avarice of the conquerors, beſtowed no longer any money on the fine arts.

The decline of the fine arts in Rome is by a *writer of taſte and elegance aſcribed to a cauſe different from any above-mentioned, a cauſe that overwhelms manhood as well as the fine arts wherever it prevails; and that is opulence, joined with its faithful attendants avarice and luxury. "In ancient times, (ſays he), when naked virtue had her admirers, the liberal arts were in their higheſt vigour; and there was a generous conteſt among men, that nothing of real and permanent advantage ſhould long remain undiſcovered. Democritus extracted the juice of every herb and plant; and, leſt the virtue of a ſingle ſtone or twig ſhould eſcape him, he conſumed a lifetime in experiments. Eudoxus, immerſed in the ſtudy of aſtronomy, ſpent his age upon the top of a mountain. Chryſippus, to ſtimulate his inventive faculty, thrice purified his genius with hellebore. To turn to the imitative arts: Lyſippus, while labouring on the forms of a ſingle ſtatue, periſhed from want. Myron, whoſe powerful hand gave to the braſs almoſt the ſoul of man and animals,—at his death found not an heir! Of us of modern times what ſhall we ſay? Immerſed in drunkenneſs and debauchery, we want the ſpirit to cultivate thoſe arts which we poſſeſs. We inveigh againſt the manners of antiquity; we ſtudy vice alone; and vice is all we teach. Where now is the art of reaſoning? Where aſtronomy? Where is the right path of wiſdom? What man now a-days is heard in our temples to make a vow for the attainment of eloquence, or for the diſcovery of the fountain of true philoſophy? Nor do we even pray for health of body, or a ſound underſtanding. One, while he has ſcarce entered the porch of the temple, devotes a gift in the event of the death of a rich relation; another prays for the diſcovery of a treaſure; a third for a miniſteral fortune. The ſenate itſelf, the exemplary preceptor of what is good and laudable, has promiſed a thouſand pounds of gold to the capitol; and, to remove all reproach from the crime of avarice, has offered a bribe to Jupiter himſelf. How ſhould we wonder that the art of painting has declined, when,

* Petronius Arbiter.

when, in the eyes both of the gods and men, there is more beauty in a mass of gold than in all the works of Phidias and Apelles."—In England, the fine arts are far from such perfection as to suffer by opulence. They are in a progress, it is true, toward maturity; but they proceed in a very slow pace.

There is still another cause that never fails to undermine a fine art in a country where it is brought to perfection, abstracting from every one of the causes above-mentioned. It is remarked a little above, that nothing is more fatal to an art or to a science than a performance so much superior to all of the kind as to extinguish emulation. This remark is exemplified in the great Newton, who, having surpassed all the ancients, has not left to his countrymen even the faintest hope of rivalling him; and to that cause is attributed the visible decline of mathematics in Great-Britain. The same cause would have been fatal to the arts of statuary and painting among the Greeks, even though they had continued a free people. The decay of painting in modern Italy is, probably, owing to the same cause: Michael Angelo, Raphael, Titian, &c. are lofty oaks that bear down young plants in their neighbourhood, and intercept from them the sunshine of emulation. Had the art of painting made a slower progress in Italy, it might have there continued in vigour to this day. Velleius Paterculus says judiciously, "Ut primo ad consequendos quos priores ducimus accendimur; ita, ubi aut præteriri aut æquari eos posse desperavimus, studium cum spe senescit; et quod adsequi non potest, sequi desinit: præteritoque eo in quo eminere non possimus, aliquid in quo nitamur conquirimus."

The decline of an art or science proceeding from the foregoing cause, is the most rapid where a strict comparison can be instituted between the works of different masters. The superiority of Newton above every other mathematician can be ascertained with precision: and hence the sudden decline of that science in Great Britain. In Italy a talent for painting continued many years in vigour, because no painter appeared with such superiority of genius as to carry perfection in every branch of the art. As one surpassed in designing, one in colouring, one in graceful attitudes, there was still scope for emulation. But when at last there was not a single perfection but what one or other master had excelled in, from that period the art began to languish. Architecture continued longer in vigour than painting, because the principles of comparison in the former are less precise than in the latter. The artist who could not rival his predecessors in an established mode, sought out a new mode for himself, which, though perhaps less elegant or perfect, was for a time supported by novelty.

11 Useful arts less subject to decline.

Useful arts will never be neglected in a country where there is any police; for every man finds his account in them. Fine arts are more precarious. They are not relished but by persons of taste, who are rare; and such as can spare great sums for supporting them are still more rare. For that reason, they will never flourish in any country, unless patronized by the sovereign, or by men of power and opulence. They merit such patronage, as one of the springs of government: and a capital spring they make, by multiplying amusements, and humanizing manners; upon which account they have always been encouraged by good princes.

12 Theory of the polite arts.

General Theory of the Polite Arts. The essence of the polite arts, as before observed, consists in *expression*. The end of all these arts is *pleasure*; whereas the end of the sciences is *instruction* and *utility*. Some of the polite arts indeed, as eloquence, poetry, and architecture, are frequently applied to objects that are useful, or exercised in matters that are instructive, as we shall show more particularly in their proper place; but in these cases, though the ground-work belongs to those sciences which employ the understanding, yet the expression arises from the inventive faculty. It is a picture that is designed by Minerva, to which the muses add the colouring, and the graces the frame. This union forms therefore the perfection of the art, according to that sententious and well known precept of Horace: *Omne tulit punctum, qui miscuit utile dulci.*

13 What arts so denominated.

Under the denomination, therefore, of Polite Arts, we comprehend, 1. Eloquence; 2. Poetry; 3. Music; 4. Painting; 5. Sculpture; 6. Graving; 7. Architecture; 8. Declamation; 9. Dancing. Particular descriptions of these arts are given under their respective names. This branch of the present article is intended as a general introduction to them; and, as such, will be occasionally referred to.

There is one very essential reflection, which it appears to us proper to make in the first place, on the polite arts in general. All the rules of the world are not sufficient to make a great poet, an able orator, or an excellent artist; because, the quality, necessary to form these, depends on the natural disposition, the fire of genius, which no human art can confer, but which is the pure gift of heaven. The rules, however, will prevent a man from being a bad artist, a dull orator, or a wretched poet; seeing they are the reflections of the greatest masters in those arts, and they point out the rocks which the artist should shun in the exercise of his talents. They are of use moreover, in facilitating his labours, and in directing him to arrive by the shortest and surest road to perfection. They refine, strengthen, and confirm, his taste. Nature abandoned to herself, has constantly something wild and savage. Art, founded on just and sagacious rules, gives her elegance, dignity, and politeness; and it is impossible to sacrifice properly to the graces, without knowing the incense that is pleasing to them.

14 Use of precepts.

15 *Beauty, genius, taste,* what.

Beauty is the object of all the polite arts. It is not, however, so easy, as it may seem, to give a clear and determinate idea of what we precisely mean by that term*. Many able writers, who have treated expressly on the subject, have shown that they were totally ignorant of what it was. It is one of those expressions that we comprehend immediately, that present us with a clear and precise idea, that leave a distinct impression on our minds, when it is simply written or pronounced; but which philosophers envelope in darkness, when they attempt to elucidate it by definitions and descriptions, and the more, as mankind have different ideas of beauty, their opinions and tastes being as various as their understandings and physiognomies. We may say, however, in general, that beauty results from the various perfections of which any object is susceptible, and which it actually possesses; and that the perfections which produce beauty consist principally in the

* See the article *Beauty*.

the agreeable and delightful proportions which are found, 1. Between the ſeveral parts of the ſame object; 2. Between each part and the whole together; 3. Between the parts and the end or deſign of the object to which they belong. *Genius*, or invention, is that faculty of the mind by which *beauty* is produced. † See *Taſte*. *Taſte* †, diſpoſition, or rather the natural ſenſation of the mind refined by art, ſerves to guide the genius in diſcerning, embracing, and producing, that which is beautiful of every kind. From whence it follows, that the general theory of the polite arts is nothing more than the knowledge of what they contain that is truly beautiful and agreeable; and it is this knowledge, this theory, which modern philoſophers call by the Latin name of *æſthetica*.

It ſhould be conſtantly remembered, that the eſſence of the polite arts conſiſts in expreſſion. This expreſſion lies ſometimes in the words, and ſometimes in the pen; ſometimes in ſounds and their harmony, and at others in corporeal attitudes; ſometimes in the pencil, or in the chiſel, and at others in the graver; ſometimes in a proper diſpoſition or judicious employment of the mechanic arts, and at others merely in their manner of acting. From whence ariſe thoſe arts that we have mentioned, and which are deſcribed in their order.

16 First general rule.

The general theory of the polite arts, or *eſthetics*, neceſſarily ſuppoſes, therefore, certain rules; but theſe general rules are of no great number. The firſt is, That whoever would devote himſelf the polite arts, ſhould above all things *conſult his genius*; diveſt himſelf of all ſelf-love; and examine if he be a true ſon of Apollo, and cheriſhed by the muſes: for

In vain, raſh author, doſt thou ſtrive to climb,
By lofty verſe, Parnaſſus' height ſublime,
If heaven does not by ſecret powers inſpire,
Or if thy natal ſtar darts not poetic fire.

17 Imagination, what.

This precept with regard to poetry in particular, is applicable to all the polite arts in general; for their moſt happy ſucceſs is founded on *imagination*. By this term we underſtand, in general, a faculty of the mind, a particular genius, a lively invention, a certain ſubtile ſpirit, which gives a facility in diſcovering ſomething new. But it is neceſſary alſo to preſcribe

18 Novelty and Invention.

juſt bounds to this term *new*, which muſt not be here taken in an abſolute ſenſe. Solomon wiſely remarks, that, even in his time, *there was nothing new under the ſun*. In fact, all that exiſts, and all that is capable of being diſcovered in the known world, has already been diſcovered. The fine arts in their imitations of nature, in their expreſſions, can borrow images, figures, compariſons, from thoſe things only that exiſt and are known. As there have been from the beginning of the world to our days, millions of authors in each of the polite arts, almoſt all the poſſible combinations of the various ſubjects have been produced by their lively imaginations; and when we hear the ignorant part of mankind talk of a work of wit or of art *that is entirely new*, that offers ideas which were before utterly unknown, that had never entered into the brain of any other man, we ſhould refer ſuch aſſertions to the claſs of popular errors; and reflect on thoſe ſtories we every day hear of certain empirics, who pretend to be alone poſſeſſed of marvellous methods of cure by means of ſimples; as if there were any plant, any ſtalk of graſs that grows in our world, that can have eſcaped the reſearches of botaniſts. But the novelty, of which we here ſpeak, conſiſts in the ingenious uſe of combinations of all the various objects of nature, that are new, happy, and agreeable, that have not yet been exhauſted, and which appear even to be inexhauſtible, and of the uſe which the artiſt makes of all new diſcoveries, which he turns to his advantage, by a judicious application. Invention therefore ſuppoſes a conſiderable fund of preliminary knowledge, ſuch as is capable of furniſhing ideas and images, to form new combinations. But there is no art by which invention itſelf can be produced; for that, as we have already ſaid, is the gift of heaven; and it is an endowment which we cannot even make uſe of whenever we pleaſe. We would rather ſay, therefore, that invention conſiſts in producing, in works of genius, *that which is unexpected;* an object, a harmony, a perfection, a thought, an expreſſion, of which we had no idea, that we could not foreſee, nor hope to find, where the artiſt has ſo happily placed it, and where we perceive it with delight. This idea appears applicable to ſuch of the polite arts as affect the mind by the hearing as well as by the ſight; and it is a matter that is highly eſſential. 19

The ſecond rule is, That every artiſt ought inceſſantly to labour in the improvement of his *taſte;* in acquiring that ſenſible, refined, and clear diſcernment, by which he will be enabled to diſtinguiſh the real beauties in each object, the ornaments that are agreeable to it, and the proportions and relations that ſubſiſt among the ſeveral parts: and by this faculty, he will be regulated in the employment of his natural talents. This labour conſiſts not only in the profound reflections he will make on the properties of objects as they relate to the fine arts, but alſo in a conſtant, aſſiduous ſtudy of the grand models of beauty. 20

2d Rule, Improvement of taſte.

The third rule to be obſerved in the practice of the polite arts, is *the imitation of nature*. Every object in the univerſe has its peculiar nature, of which the artiſt ſhould never loſe ſight in his manner of treating it. In vain will he otherwiſe ornament his work with the moſt refined and moſt brilliant ſtrokes; for, if nature be not juſtly imitated, it will for ever remain imperfect. The ſublime Homer has ſometimes ſinned againſt this rule: for, as the gods have a nature peculiar to themſelves, it cannot be a juſt imitation when we attribute to them paſſions that are ſcarce pardonable in mortals, and make them frequently converſe in a language that is at once vulgar and ridiculous. It was not to imitate nature, to put into the mouth of a hero, at the moment of a deciſive battle, an harangue that muſt become tedious by its exceſſive length, and which certainly could not have been heard by the thouſandth-part of a numerous army: but we have already touched upon ſome of the faults that are ſtrewed over the poems of that great man; to multiply or dwell upon them would be ungrateful. We muſt, however, obſerve that this imitation of nature, which appears at firſt view ſo ſimple and ſo eaſy, is of all things the moſt difficult in practice; and that it requires a diſcernment ſo ſagacious, and an expreſſion ſo happy, as is rarely beſtowed by heaven on mortal man. 21

3d, Imitation of nature.

Perſpicuity forms the fourth rule of expreſſion. In all the fine arts, in general, an obſcure, perplexed, ambiguous, and elaborate expreſſion, is always bad. The

4th, Perſpicuity.

true ſtriking beauty muſt be manifeſt and perceptible to the moſt ignorant of mankind as well as the moſt learned. Thoſe are ever falſe or inferior beauties that have occaſion for a covering, a kind of veil that may make them appear greater than they really are: true beauty wants no veil, but ſhines by its native luſtre. From the union of the true imitation of nature with perſpicuity of expreſſion, ariſes that *truth* which is ſo eſſential in the productions of the fine arts.

22
5th, Elevation of ſentiment.

In all the polite arts, and in all the ſubjects they embrace, there muſt neceſſarily reign an elevation of ſentiment, that expreſſes each object in the greateſt perfection of which it is ſuſceptible; that imitates nature in her moſt exalted beauty. This makes the fifth general rule. The deſign of the fine arts being to excite pleaſure by the expreſſion of that which is beautiful, every artiſt ſhould raiſe himſelf above the ſubject; and, chooſing the moſt favourable light wherein to place it, ſhould there embelliſh it with the greateſt, moſt noble, and beautiful ornaments, that his own genius can ſuggeſt; ſtill, however, obſerving a ſtrict imitation of nature.

23
6th, The ſublime to be endeavoured after.

From the obſervation of theſe two laſt rules reſults the *ſublime*, which is the union of the greateſt perſpicuity with the ſtricteſt truth and moſt exalted elevation poſſible. It is neceſſary to remark here, that the moſt ſimple and common ſubjects are ſuſceptible of a ſublime that is agreeable to their nature. An idyl or landſcape may be as ſublime in their kinds as an epic poem or a hiſtory-piece. When Moſes begins the book of Geneſis with theſe words, *In the beginning God created the heaven and the earth;* or when he tells us, that God ſaid, *Let there be light, and there was light;* theſe expreſſions are ſublime in the higheſt degree, becauſe they are perfectly clear, true, and elevated. Every author ſhould therefore endeavour after the ſublime* in every ſubject that he undertakes; and this makes the ſixth and laſt general rule in the practice of the polite arts. But if he cannot attain to this, it is, however, indiſpenſably neceſſary that he conſtantly make uſe of expreſſions that are *noble and refined*. Every thing that is *low*, *indecent*, or *diſagreeable*, is naturally repugnant to the ſublime, and ought to be for ever baniſhed from all works that proceed from the noble and liberal arts.

* See the article Grandeur *and Sublimity*.

Art is alſo an appellation given to ſeveral ſuperſtitious practices, as, *St Anſelhm's art*, *St Paul's art*, &c.

Art and Part, in Scots law. See Accessory.

ARTA, by ſome called *Larta*, a town of Lower Albania, in Turkey in Europe, with a Greek archbiſhop's ſee. It is a pretty large town, and contains about 7 or 8000 inhabitants, Greeks and Turks, but the former are the moſt numerous. The cathedral has as many windows and doors as there are days in the year. It is ſupported by above 2000 marble pillars; and was built by Michael Ducas Commeno emperor of Conſtantinople, as appears by an inſcription over the great door. It carries on a conſiderable trade, particularly in tobacco and furs. E Long. 31. 30. N. Lat. 39. 28.

ARTABA, an ancient meaſure of capacity uſed by the Perſians, Medes, and Egyptians.

The Perſian artaba is repreſented by Herodotus as bigger than the Attic medimnus by three Attic choenixes: from which it appears that it was equal to $6\frac{3}{4}$ Roman modii, conſequently that it contained $166\frac{2}{3}$ pounds of wine or water, or $126\frac{2}{3}$ pounds of wheat. The Egyptian artaba contained five Roman modii, and fell ſhort of the Attic medimnus by one modius; conſequently held $133\frac{1}{3}$ pounds of water or wine, 100 pounds of wheat, or 60 of flour.

ARTABANUS, the name of ſeveral kings of Parthia. See Parthia.

ARTABAZUS, the ſon of Pharnaces, commanded the Parthians and Choraſmians in the famous expedition of Xerxes. After the battle of Salamis, he eſcorted the king his maſter to the Helleſpont with 60,000 choſen men; and after the battle of Platæa, in which Mardonius engaged contrary to his advice, he made a noble retreat, and returned to Aſia with 40,000 men under his command.

ARTAXATA, *orum*, the royal reſidence and metropolis of Armenia Major (Strabo, Pliny, Juvenal); and built according to a plan of Hannibal, for king Artaxias, after whom it was called. It was ſituated on an elbow of the river Araxes, which formed a kind of peninſula, and ſurrounded the town like a wall, except on the ſide of the Iſthmus, but this ſide was ſecured by a rampart and ditch. This town was deemed ſo ſtrong, that Lucullus, after having defeated Tigranes, durſt not lay ſiege to it; but Pompey compelled him to deliver it up without ſtriking a blow. It was then levelled with the ground; but the Armenians have a tradition, that the ruins of it are ſtill to be ſeen at a place called *Ardachat*. Sir John Chardin ſays, that it has the name of *Ardachat* from Artaxias, whom in the Eaſt they call *Ardechier*. Here are the remains of a ſtately palace which the Armenians take to be that of Tiridates who reigned in the time of Conſtantine the Great. One front of this building is but half ruined, and there are many other fine antiquities which the inhabitants call *Tact. Tradat*, that is, the throne of Tiridates. Tavernier alſo mentions the ruins of Artaxata between Erivan and mount Ararat, but does not ſpecify them. The ancient geographers mention another city of the ſame name, likewiſe ſituated on the Araxes, but in the northern part of Media, known among the ancients by the name of *Atropatia*.

ARTAXERXES, the name of ſeveral kings of Perſia. See Persia.

ARTEDIA: A genus of the digynia order, belonging to the pentandria claſs of plants; and in the natural method ranking under the 45th order, *Umbellatæ*. The involucra are pinnatifid; the floſcules of the diſc are maſculine; and the fruit is hiſpid with ſcales.—There is but one ſpecies, the ſquamata with ſquamoſe ſeeds, a native of the Eaſt: Rewvolf found it growing on mount Libanus. It is an annual plant, whoſe ſtalks riſe about two feet high, ſending out a few ſide branches, which are garniſhed with narrow compound leaves reſembling thoſe of dill; the extremity of the ſtalk is terminated by a large umbel of white flowers, compoſed of five unequal petals. Theſe are ſucceeded by roundiſh compreſſed fruit, each having two ſeeds, whoſe borders are ſcaly.

ARTEMIDORUS, famous for his Treatiſe on Dreams. He was born at Epheſus, but took upon him the ſurname of *Daldianus* in this book, by way of reſpect to his mother's country, Daltis. He ſtyled himſelf

Artemisia. ſelf *the Epheſian* in his own performances. He not only bought up all that had been written concerning the explication of dreams which amounted to many volumes: but he likewiſe ſpent many years in travelling, in order to contract an acquaintance with fortune-tellers: he alſo carried on an extenſive correſpondence with all the people of this ſort in the cities and aſſemblies of Greece, Italy, and the moſt populous iſlands; collecting at the ſame time all the old dreams, and the events which are ſaid to have followed them. The work which he wrote on dreams conſiſted of five books: the firſt three were dedicated to one Caſſius Maximus; and the laſt two to his ſon, whom he took a good deal of pains to inſtruct in the nature and interpretation of dreams. This work, though filled with frivolous obſervations, contains ſome things that are intereſting. It was firſt printed in Greek at Venice in 1518; and Rigaltius publiſhed an edition at Paris, in Greek and Latin, in 1603, and added ſome notes. Artemidorus wrote alſo a treatiſe upon Auguries, and another upon Chiromancy; but they are not exſtant. He lived under the emperor Antoninus Pius.

ARTEMISIA, wife of Mauſolus king of Caria, has immortalized herſelf by the honours which ſhe paid to the memory of her huſband. She built for him in Halicarnaſſus a very magnificent tomb, called the *Mauſoleum*, which was one of the ſeven wonders of the world, and from which the title of *Mauſoleum* was afterwards given to all tombs remarkable for their grandeur; but ſhe died of regret and ſorrow before the Mauſoleum was finiſhed. She appointed panegyrics to be made in honour of him, and propoſed a prize of great value for the perſon who ſhould compoſe the beſt. He died about the end of the 106th Olympiad, 351 years before the Chriſtian æra.

ARTEMISIA, queen of Caria, and the daughter of Ligdamis, marched in perſon in the expedition of Xerxes againſt the Greeks, and performed wonders in the ſea-fight near Salamis, 480 years before the Chriſtian æra. Being purſued by an Athenian veſſel, ſhe attacked one of the Perſian ſhips, commanded by Demaſithymus, king of Calyndus, her enemy, and ſunk it; on which the Athenians, thinking that her ſhip was on the ſide of the Greeks, ceaſed their purſuit: but Xerxes was the principal perſon impoſed upon in this affair; for believing ſhe had ſunk an Athenian veſſel, he declared, that "the men had behaved like women, and the women like men." Xerxes intruſted her with the care of the young princes of Perſia, his ſons, when, agreeably to her advice, he abandoned Greece, in order to return to Aſia. Theſe great qualities did not ſecure her from the weakneſs of love: ſhe was paſſionately fond of a man of Abydos, whoſe name was Dardanus, and was ſo enraged at his neglect of her, that ſhe put out his eyes while he was aſleep. The gods, in order to puniſh her for this, inſpired her with a ſtill ſtronger paſſion for him; ſo that the oracle having adviſed her to go to Leucas, which was the uſage of deſperate lovers, ſhe took the leap from thence, and was interred in that place.—Many writers confound this Artemiſia with the former, the wife of Mauſolus.

ARTEMISIA, *Mugwort, Southernwood,* and *Wormwood:* A genus of the polygamia ſuperflua order, belonging to the ſyngeneſia claſs of plants; and in the natural method rank under the 49th order, *Compoſitæ-nucamentaceæ*. The receptacle is either naked, or a little downy; it has no pappus; the calyx is imbricated with roundiſh ſcales; and the corolla has no radii.—The

Species are 23; of which the moſt noted are the following. 1. The vulgaris, or common mugwort, grows naturally on banks and by the ſides of foot-paths in many parts of Britain; ſo is ſeldom admitted into gardens, where it would prove a troubleſome weed, as it ſpreads very faſt by its creeping roots. It flowers in June, at which time the plant is ready for uſe. 2. The dracunculus, or tarragon, which is frequently uſed in ſallads, eſpecially by the French, is a very hardy plant, and ſpreads greatly by its creeping roots. 3. The abrotanum, or ſouthernwood, which is kept in gardens for the ſake of its agreeable ſcent, is a low ſhrub, ſeldom riſing more than three or four feet high, ſending out lateral ſhruby branches, growing erect, garniſhed with five briſtly leaves, having an agreeable ſcent when bruiſed: the flowers are produced in ſpikes from the extremity of the branches; but unleſs the autumn proves warm, they ſeldom open in England. 4. The ſantonicum produces the ſemen ſantonicum, which is much uſed for worms in children. It grows naturally in Perſia, from whence the ſeeds are brought to Europe. It hath the appearance of wild mugwort; the branches are ſlender, erect, and garniſhed with linear winged leaves, and terminate by recurved ſlender ſpikes of flowers which have naked receptacles. 5. The artemiſia maritima, or ſea-wormwood, grows naturally on the ſea-coaſts in moſt parts of Britain, where there are ſeveral varieties, if not diſtinct ſpecies, to be found. Theſe are low under ſhrubs, moſt of which creep at the root, by which they multiply greatly in their natural ſituation, but when tranſplanted into gardens ſeldom thrive ſo well. 6. The pontica, or pontic wormwood, commonly called *Roman wormwood*, is a low herbaceous plant, whoſe ſtalks die in autumn, and new ones appear in the ſpring. Theſe are garniſhed with finely-divided leaves, whoſe under-ſides are woolly: and the upper part of the ſtalks are furniſhed with globular flowers which nod on one ſide, having naked receptacles. Theſe appear in Auguſt, but are rarely ſucceeded by ſeeds in Britain. 7. The abſinthium, or common worm-wood, grows naturally in lanes and uncultivated places, and is too well known to require any particular deſcription. 8. The arboreſcens, or tree-wormwood, grows naturally in Italy and the Levant near the ſea. It riſes, with a woody ſtalk, ſix or ſeven feet high, ſending out many ligneous branches, garniſhed with leaves ſomewhat like thoſe of the common wormwood, but more finely divided, and much whiter. The branches are terminated by ſpikes of globular flowers in the autumn, which are ſeldom ſucceeded by ſeeds in Britain.

Culture. The ſouthernwood is propagated by ſlips or cuttings planted in a ſhady border about the beginning of April, obſerving to water them duly in dry weather. In this border they may remain till the following autumn, when they ſhould be tranſplanted, either into pots or thoſe parts of the garden where they are to remain. The ſantonicum is likewiſe propagated by ſlips: but the plants ſhould be placed in a dry ſoil and ſheltered ſituation, where they will endure the cold of

Artemisia. of our ordinary winters pretty well; though it will be proper to have a plant or two in pots, which may be ſheltered under a common hot-bed frame in winter, to preserve the ſpecies. The true wormwood is eaſily propagated in the ſame manner. The cuttings muſt be planted in a ſhady border, and duly watered during the ſummer ſeaſon, in which caſe they will take root freely. In autumn, ſome of the young plants ſhould be potted, that they may be ſheltered in winter; the others may be planted in a warm border, where they will live, provided the winter proves favourable. The other ſorts ſpread by their creeping roots; and require no culture, as they are very hardy, and will thrive any where.

Medicinal Uſes. The ſeeds of the ſantonicum are ſmall, light, chaffy, compoſed as it were of a number of thin membranous coats, of a yellowiſh colour, an unpleaſant ſmell, and a very bitter taſte. They are celebrated for anthelmintic virtues (which they have in common with other bitters), and are ſometimes taken in this intention, either along with molaſſes or candied with ſugar. They are not very often met with genuine in the ſhops. The leaves of the ſea, common, and Roman wormwoods, are uſed as ſtomachics, but are all very diſagreeable: the Roman is the leaſt ſo, and therefore is to be preferred; but the other two kinds are generally ſubſtituted in its place. The diſtilled oil of wormwood is ſometimes made uſe of to rub on the belly as a cure for worms.

The leaves of the vulgaris, or common mugwort, have a light aromatic ſmell, and an herbaceous bitteriſh taſte. They were formerly celebrated as uterine and antihyſteric: an infuſion of them is ſometimes drank, either alone or in conjunction with other ſubſtances, in ſuppreſſion of the menſtrual evacuations. This medicine is certainly a very mild one, and conſiderably leſs hot than moſt others to which theſe virtues are attributed. In ſome parts of Britain, mugwort is of common uſe as a pot-herb. It is now, however, very little employed in medicine; and it is probably with propriety that the London College have rejected it from their pharmacopœia.

The moxa, ſo famous in the eaſtern countries for curing the gout by burning it on the part affected, is the lanugo or down growing on the under ſide of the leaves of a ſpecies of mugwort, ſuppoſed to be the ſame with the common ſort. From ſome dried ſamples of this plant which were brought into England Mr Miller reckons them to be the ſame, differing only in ſize; in which the Eaſt Indian kind is inferior to it. He ſuppoſes that the lanugo of our mugwort would be equally efficacious. But according to Abbé Groſier, "the leaves are more deeply indented than thoſe of the common kind; it is alſo ſofter, and of a more ſilky texture. The ancient Chineſe made great uſe of it in medicine. In all the northern provinces, the principal remedy for moſt diſeaſes conſiſted in making deep punctures in the body, upon which ſmall balls of the down of this plant were burnt. Theſe punctures were made with needles of gold or ſteel, without drawing blood; and all the ſkill required in the phyſician, was to determine their number and depth, and where it was neceſſary to make them. It was neceſſary that the down of the mugwort ſhould be very old; and, as every kind of fire was not proper for lighting theſe ſalutary balls, they employed mirrors made of ice or metal. "They cauſed the water to freeze (ſays the ancient text) in a round convex veſſel; and the ice being preſented to the ſun, collected its rays, and ſet fire to the down of the plant." The literati are not at preſent agreed whether the ſecret of curing diſeaſes by punctures be preſerved; but theſe downy balls are ſtill uſed inſtead of cupping-glaſſes in apoplectic and lethargic caſes. Girdles made of this down are alſo recommended for the ſciatica, and thoſe afflicted with the rheumatiſm in their legs are adviſed to quilt their ſtockings with it. The mugwort deſtined for this purpoſe is gathered only in autumn; and care muſt be taken to pick that which has the ſhorteſt and ſofteſt down.

Hiſt. of China.

"In China, the juice of the common mugwort, when green, is uſed to ſtop ſpitting of blood: and the ſeeds are employed for the ſame purpoſe. The doſe of the latter is divided into two parts; one of which is reduced to aſhes, and put into water in which the other has been boiled. Theſe aſhes, it is ſaid, when taken as ſnuff, immediately ſtop bleedings of the noſe. The Chineſe preſcribe this plant alſo with ſucceſs for dyſenteries which proceed from weakneſs, and for pleuriſies, and diſorders of the ſtomach. An infuſion of the ſtalks and buttons of mugwort is recommended to old people inſtead of tea.—Mugwort was formerly conſidered there as a powerful preſervative againſt witchcraft. The ancient books relate, that, in the third century of the Chriſtian æra, it was cuſtomary for people to gather this plant before ſun-riſe, and to ſuſpend it afterwards over their doors. The poets of the ſeventh century mention this cuſtom, and deſcribe the manner in which the ſtreets of the capital were ornamented with it on the fifth day of the fifth moon; that is to ſay, about midſummer.

"Of a ſpecies which bears prickles on the edges of its leaves, the leaves, when dried, are beaten with a wooden bat until the ſoft part is entirely ſeparated from the fibres; and, after they have been dipped in water mixed with ſaltpetre, they are uſed for tinder; no other kind is known at Pe-king; and it is equal to that of Europe. It appears that the ancient Chineſe made uſe of the ſoft part of this plant for quilting, for making mattreſſes, and even for cloth. They alſo employed it for manufacturing a kind of paper."

Artemiſia, Artemiſium.

ARTEMISIUM (anc. geog.), a promontory on the north-eaſt of Eubœa (called *Leon* and *Cale Acte* by Ptolemy), memorable for the firſt ſea-engagements between the Greeks and Xerxes.

The Grecian fleet was ſtationed in the harbour; while that of the Perſians, too numerous for any harbour to contain, had anchored in the road that extends between the city of Caſtanæa and the promontory of Sepias, on the coaſt of Theſſaly.

The firſt line of their fleet was ſheltered by the coaſt of Theſſaly; but the other lines, to the number of ſeven, rode at anchor, at ſmall intervals, with the prows of the veſſels turned to the ſea. When they adopted this arrangement, the waters were ſmooth, the ſky clear, the weather calm and ſerene: but on the morning of the ſecond day after their arrival on the coaſt, the ſky began to lour; the appearance of the heavens grew threatening and terrible; a dreadful ſtorm ſucceeded; and for three days raged with unabating fury. Four hundred

hundred galleys were destroyed by its violence, besides a vast number of storeships and transports. Eight hundred ships of war, however, besides innumerable vessels of burthen, sailed into the Pegasean bay, and anchored in the road of Apheté, which, at the distance of a few miles, lies directly opposite to the harbour of Artemisium.

From *Gillies's History of Greece.*

The Grecians had posted centinels on the heights of Euboea to observe the consequences of the storm, and to watch the motion of the enemy. When informed of the disaster which had befallen them, they poured out a joyous libation, and sacrificed, with pious gratitude, to "Neptune the Deliverer."

The Persians, however, having recovered from the terrors of the storm, prepared for battle; and as they entertained not the smallest doubt of conquering, they detached 200 of their best sailing vessels round the isle of Euboea, to intercept the expected flight of the enemy through the narrow Euripus.

About sun-set the Grecian fleet approached in a line; and the Persians met them with the confidence of victory, as their ships were still sufficiently numerous to surround those of their opponents. At the first signal the Greeks formed into a circle, at the second they began the fight. Though crowded into a narrow compass, and having the enemy on every side, they soon took 30 of their ships, and sunk many more. Night came on, accompanied with an impetuous storm of rain and thunder; the Greeks retired into the harbour of Artemisium; the enemy were driven to the coast of Thessaly.

By good fortune, however, rather than by design, the greatest part of the Persian fleet escaped immediate destruction, and gained the Pegasean bay; but the ships ordered to sail round Euboea met with a more dreadful disaster. They were overtaken by the storm, after they had adventured further from the shore than was usual with the wary mariners of antiquity. Clouds soon intercepted the stars, by which alone they directed their course; and after continuing during the greatest part of the night the sport of the elements, they all perished miserably amidst the shoals and rocks of an unknown coast.

The morning arose with different prospects and hopes to the Persians and the Greeks. To the former it discovered the extent of their misfortunes; to the latter it brought a reinforcement of 53 Athenian ships. Encouraged by this favourable circumstance, they determined again to attack the enemy, at the same hour as on the preceding day, because their knowledge of the coast and their skill in fighting their ships rendered the dusk peculiarly propitious to their designs. At the appointed time, they sailed towards the road of Apheté; and having cut off the Cilician squadron from the rest, totally destroyed it, and returned at night to Artemisium.—The Persian commanders being deeply affected with their repeated disasters, but still more alarmed at the much dreaded resentment of their king, they determined to make one vigorous effort for restoring the glory of their arms. By art and stratagem, and under favour of the night, the Greeks had hitherto gained many important advantages. It now belonged to the Persians to choose the time for action. On the third day at noon, they sailed forth in the form of a crescent, which was still sufficiently extensive to infold the Grecian line. The Greeks, animated by former success, were averse to decline any offer of battle; yet it is probable that their admirals, and particularly Themistocles, would much rather have delayed it to a more favourable opportunity. Rage, resentment, and indignation, supplied the defect of the Barbarians in skill and courage. The battle was longer, and more doubtful, than on any former occasion; many Grecian vessels were destroyed, five were taken by the Egyptians, who particularly signalized themselves on the side of the Barbarians, as the Athenians did on that of the Greeks. The persevering valour of the latter at length prevailed, the enemy retiring, and acknowledging their superiority, by leaving them in possession of the dead and the wreck. But the victory cost them dear; since their vessels, particularly those of the Athenians, were reduced to a very shattered condition; and their great inferiority in the number and size of their ships, made them feel more sensibly every diminution of strength.

Artemisium, a town of Oenotria, (Stephanus): now *S. Agatha*, in the Hither Calabria, on the river Pisaurus, or la Foglia, distant eight miles from the Tuscan sea.—Another of the Contestani, in Spain, (Strabo); otherwise called *Dianium:* now *Denia*, on the sea-coast of Valencia.

ARTERIOTOMY, the opening an artery, with design to procure an evacuation of blood. See Surgery.

ARTERY, in anatomy, a conical tube or canal which conveys the blood from the heart to all parts of the body. See Anatomy, n° 117,—125.

ARTHRITIS, in medicine, the gout. See the *Index* subjoined to Medicine.

ARTHRODIA, in natural history, a genus of imperfect crystals, found always in complex masses, and forming long single pyramids, with very short and slender columns.

Arthrodia, in anatomy, a species of articulation, wherein the flat head of one bone is received into a shallow socket in the other. The humerus and scapula are joined by this species of articulation.

ARTHUR, the celebrated hero of the Britons, is said to have been the son of Uther Pendragon king of Britain, and to have been born in 501. His life is a continued scene of wonders. It is said that he killed four hundred and seventy Saxons with his own hand in one day; and after having subdued many mighty nations, and instituted the order of the Knights of the Round Table, died A. D. 542, of wounds which he received in battle. The most particular detail of his story and his exploits is that given by Geffroy of Monmouth: but the probable is there so blended with the mavellous and the extravagant, that not only the truth of the whole, but even the reality of Arthur's existence has been called in question.

In this controversy, Mr Whittaker has taken much pains to vindicate the existence, and discriminate between the real and the fabulous transactions, of the British worthy. "Many of the actions (he observes) attributed to Arthur by the Welch chronicles of Britain, are as absurd in themselves as they are spurious in their authority. Written, as those narratives were many centuries after the facts, and being merely the authentic accounts of Arthur, embellished with the fictions and distorted by the perversions of folly; they are inconsistent equally with the state of the times, and the

Arthur. the history of the continent and the island. And the ignorance of the forgers, and the credulity of their abettors, can be equalled only by the injudiciousness and incredulity of the opponents to both. If some accounts of Arthur and Cunobeline in these histories be certainly spurious, others are as certainly genuine. And the relations of Suetonius, Dio, and Nennius, are not to be rejected, because of the falsehoods which imposture has engrafted upon them, and absurdity admitted with them.

History of Manchester, vol. ii. 4to. edit. p. 31. *et seq.*

"The existence of Arthur is evinced by that of the fables, which have at once annihilated his actions and his name with the misjudging critic. And the reasoners own arguments really turn against himself, and demonstrate the point which they were intended to disprove. The annals of Wales have long laboured in Arthur's commendation. The highlanders have long had a poetical history of his exploits in their own language. The whole island is in traditionary possession of his character, and 600 or 700 places within it are still distinguished by his name.

"The genuine actions of the chief are mentioned by his own historians, with a modesty and conciseness that is no bad argument of the truth, and with a particularity of time and place that is a good evidence of the facts. They are noticed by men whom the death of the hero had exempted from all temptation to flattery: they are recited by persons, whom a proximity to the times had precluded from all possibility of mistake: and they are attested by the best historical authority, writers who lived cotemporary with him, authors who conversed with his warriors, and historians that wrote within a few years after him. He is spoken of as the honourable father of the British heroes by the aged Llomarch, a writer actually cotemporary with him, and some time resident at his court. One of his greater actions is incidentally recorded by Taliesin, an historical bard living under Maelgwn Gwined, who was a sovereign among the Britons in the days of Arthur, Gildas, and Llomarch. Another of his considerable exploits is casually intimated by Myrdhin Wyhlt or Merlinus Caledonius, who complains of the severe treatment which he himself received from Rydderch Hael, a king cotemporary with Urien Reged, and engaged with him in a war against the Saxons on the death of Ida in 560. And all his actions are particularly recited by Nennius.

"In the *Historia Britonum* of this last author, Arthur's victories over the Saxons are thus recorded. The first battle was fought at the mouth of the river, which is denominated *Glem*. The second, third, fourth, and fifth, were upon another river, that is called *Duglas*, and lies in the region Linuis. The sixth was on a stream, which bears the appellation of *Bassas*. The seventh was in the wood of Celidon, that is, in Cat Coit Celidon. The eighth was at Castle Gunnion. And the ninth was at the city of the Legion. The tenth was on the bank of the river Ribroit; the eleventh at the hill AgnedCathregonion; and the twelfth at Mount Badon. These twelve battles of Arthur are described to us in the same manner as Vortimer's three. Only the general facts are mentioned, and only the common names of places are recited, in both. And from the whole air and aspect of the history, the remarkable conciseness with which the notices are given, and the great ease with which the places are pointed out, the detail appears to have been drawn up at the distance only of a few years from the transactions, and when these little references were sufficiently understood."

Mr. Whittaker proceeds to ascertain the scenes of Arthur's battles; after which he gives a relation of them with a surprising particularity. A severe critic might be apt to say, as Dr. Kippis observes, that it requires all our faith in the author's judgment, as well as in his ingenuity and learning, not to suspect that he sometimes allows too much scope to fancy and conjecture. However, the whole of what he hath advanced is singularly curious, and deserves peculiar attention and consideration. And no one can help admiring the penetration with which he hath formed such a regular detail of facts, from the combined aid of history, romance, and tradition. According to Mr Whittaker, Arthur's principal exploits were against the northern Saxons, whilst he was only prince of the Silures, and Ambrosius was the dictator or pendragon of the Britons. "In a series probably of five campaigns, and in a succession certainly of eleven victories, this great commander had repelled the Saxons from the north of Flavia, dislodged them from all Maxima, and dispossessed them of all Valentia. And these were successes so unchequered with misfortunes, so great in themselves, and so beneficial to the public, that the name of Arthur claims the first rank in the list of military, and the better one of patriot, heroes." The twelfth battle of Arthur was fought in the south of England, after he was elected to the pendragonship, against Cerdic the Saxon. "This (says Mr Whittaker) was a most extraordinary victory, and completes the circle of Arthur's military glories." In the author's account of this prince's conduct in peace, he asserts, that "Arthur saw that an appointment was wanted, which should at once be a more regular and more honourable signature of merit; by the certainty of the honour and the greatness of the dignity, call out all the worth of all the worthy in the nation; and collect it round the throne of the pendragon. Accordingly he established a military order. It was the first that had ever been instituted in the island; and it has since been imitated by all the nations on the continent. By means of this association, Arthur raised among the provincials a general glow of ingenuous heroism, the first spirit of chivalry that ever appeared in Europe; that manly and honourable gallantry of soul, which has made him and his worthies the subject of romantic histories over all the west of it. By this, and this alone, could he have been what history represents him, the Reverend Father of the British Heroes in general, even to the conclusion of the sixth century, and nearly the middle of the seventh. The order naturally survived its founder. And the members of it were denominated the Warriors of Arthur, though the persons were born half a century after his death." Mr Whittaker goes on to inform us, that, under the prudent management of Arthur for 20 years together, a fair prospect dawned upon the Britons, and long scenes of future glories opened to their imaginations. "But the gay vision was destroyed at once by the commencement of a civil war. Many towns still remained in ruins, the memorial of the former wars, and the disgrace of the present. The diffused spirit of chivalry was turned up-

Ibid. p. 43—64.

on the nation, and heroiſm became the tool of diſſenſion. And the dreadful combination of civil evils was begun and conſummated, at once, by the death of the renowned Arthur in battle. Thus died the incomparable hero in 542."

To theſe obſervations it may not be improper to add the following account of the diſcovery of Arthur's tomb, which appears to be tolerably well authenticated. Henry II. who was the firſt of the Plantagenet line, being, in the laſt year of his reign, at Pembroke, and hearing there a Welſh bard ſinging to his harp the ſtory of Arthur, concluding with an account of his death and burial in the church-yard of Glaſtenbury between two pyramids; the king inſtantly gave orders that the matter ſhould be enquired into, and the body dug up. This was done as the king directed; and at the depth of ſeven feet was found a vaſt ſtone, whereon was faſtened a leaden croſs, with this inſcription on the inſide: *Hic Jacet Sepultus Inclytus Rex Arturius in Inſula Avalonia*; i. e. "Here lies the famous King Arthur, buried in the iſle of Avalon." Digging ſtill lower, they found the king's body in the trunk of a tree, his beautiful queen lying by him, with long flowing hair, in colour bright as gold, which however ſunk into duſt when touched. The king's bones were very large ſized; and in his ſkull there were ten wounds or more, all cicatrized, except that of which he died. This diſcovery was made in the year 1189, as Giraldus Cambrenſis tells us, who ſaw theſe bones, and examined the whole matter carefully. There was alſo a table containing this ſtory, ſet up in the monaſtery of Glaſtenbury, and the leaden croſs with the inſcription remained there till the diſſolution of the monaſtery, where it was ſeen by the great antiquary Leland, but what is become of it ſince does not appear.

On the different places above alluded to as being diſtinguiſhed by our hero's name, and ſerving to evince his exiſtence, the following may be mentioned as one of the principal.

Arthur's Seat, a high hill in the neighbourhood of Edinburgh, ſaid to have been ſo denominated from a tradition that king Arthur ſurveyed the country from its ſummit, and had alſo defeated the Saxons in its neighbourhood. This hill riſes by a ſteep and rugged aſcent, till it terminates in a rocky point near 700 feet high from the baſe, being more than double the height of the croſs on the top of St. Paul's, London, which is 340 feet. On the ſouth it is in many parts a perpendicular rock, compoſed of baſaltic pillars, regularly pentagonal or hexagonal, about three feet in diameter, and from 40 to 50 feet in height. Contiguous, upon the weſt, and partly connected with it at the baſe, are Saliſbury craggs, of inferior height, but exhibiting an appearance equally ſingular and grand. They preſent to the city an awful front of broken rocks and precipices, forming a ſort of natural amphitheatre of ſolid rock; and backward from the craggy verge above, the hill forms an extenſive irregular ſlope, the ſurface affording paſture to numerous flocks of ſheep. The craggs, beſides ores, ſpars, rock-plants, and here and there it is ſaid ſome precious ſtones, afford an inexhauſtible ſupply of granite for paving the ſtreets and other purpoſes. In quarrying, a part of the craggs has been worn down into a ſpacious ſhelf, having the appearance of a lofty terrace, and ſtretching a conſiderable length. From hence is a near and diſtinct proſpect of the city with its environs and the adjacent country. But from the pinnacle called Arthur's Seat the view is more noble and extenſive. The traveller may here ſit and ſurvey at his eaſe the centre of the kingdom, beſides having a complete view of Edinburgh and its caſtle, on which he looks down as if ſeated among the clouds. In a word, the German ocean, the whole courſe of the Forth, the diſtant Grampians, and a large portion of the moſt populous and beſt cultivated part of Scotland, form a landſcape ſublime, various, and beautiful.

The denomination of this hill, derived as above, has been adduced as an argument againſt thoſe who diſpute the exiſtence of the Britiſh Arthur. That derivation, however, though probable, is not without uncertainty. For *Arthur's Seat* is ſaid to be derived, or rather corrupted, from *Ard Seir*, a "place or field of arrows," where people ſhoot at a mark: And this not improperly; for among theſe cliffs is a dell or recluſe valley, where the wind can ſcarcely reach, now called the *Hunter's bog*, the bottom of it being a moraſs. The adjacent craggs are ſuppoſed to have taken their name from the Earl of *Saliſbury*, who in the reign of Edward III. accompanied that prince in an expedition againſt the Scots.

ARTICHOAK, in botany. See Cinara.

ARTICLE, a clauſe or condition of a contract, treaty, &c. It is alſo a ſmall part or diviſion of a diſcourſe, book, or writing, &c.

Article of Death, the laſt pangs or agony of one juſt expiring.

Article of Faith, is by ſome defined a point of Chriſtian doctrine, which we are obliged to believe, as having been revealed by God himſelf, and allowed and eſtabliſhed as ſuch by the church.

The thirty-nine articles were founded, for the moſt part, upon a body of articles compiled and publiſhed in the reign of Edward VI. They were firſt paſſed in the convocation, and confirmed by royal authority in the year 1562. They were afterwards ratified anew in the year 1571, and again by Charles I. The law requires a ſubſcription to theſe articles of all perſons ordained to be deacons or prieſts, 13 El. cap. 12. of all clergymen inducted to any eccleſiaſtical living, by the ſame ſtatute, and of licenſed lecturers and curates, 13 El. cap. 12. and 13. and 14. Ch. 2. cap. 4. of the heads of colleges, of chancellors, officials and commiſſaries, and of ſchool-maſters. By 1 Will. 3. cap. 18. diſſenting teachers are to ſubſcribe all, except the 34th, 35th, and 36th, and part of the 20th (and in the caſe of Anabaptiſts, except alſo part of the 27th); otherwiſe they are exempted from the benefits of the act of toleration.

Article, in grammar, denotes a particle uſed in moſt languages for the declining of nouns, and denoting the ſeveral caſes and genders thereof.

The uſe of articles ariſes chiefly hence, that in languages which have no different terminations, to expreſs the different ſtates and circumſtances of nouns, there is ſomething required to ſupply that office.

The Latins have no articles; but the Greeks, and moſt of the modern languages, have had recourſe to them for fixing and aſcertaining the vague ſignification of common and appellative names.

The

The Greeks have their ο, the eastern tongues their *he emphaticum*; the Italians their *il*, *lo*, and *la*. The French their *le*, *la*, and *les*. The Germans their *der*, *das*, *dat*.

The English also have two articles *a* and *the*; which being prefixed to substantives, apply their general signification to some particular things.

Some grammarians make the article a distinct part of speech; others will have it a pronoun, and others a noun adjective. See GRAMMAR.

Articles are of great service in a language, as they contribute to the more neat and precise expressing of several properties and relations, which must otherwise be lost. And hence one great advantage of such languages over the Latin, in that the article being either expressed or left out, makes an alteration in the sense, which the Latins cannot distinguish. Thus when the devil said to our Saviour, *Se tu es Filius Dei*, it may be either understood, "if thou art *a* son of God," or, "if thou art *the* son of God." The Italians even prefix articles to proper names, which do not naturally need any, because they themselves signify things individually. Thus they say, *il Ariosto, il Tasso, il Petrarcha*. Even the French join the article to the proper names of kingdoms, provinces, &c. as *la Suede*, *la Normandie*. And we likewise annex it to the names of certain mountains and rivers; as The *Rhine*, The *Danube*, The *Alps*, &c.

ARTICULATE SOUNDS are such sounds as express the letters, syllables, or words, of any alphabet or language; such are formed by the human voice, and by some few birds, as parrots, &c.

ARTICULATION, or JOINTING, is the joining of bones together. See ANATOMY, nº 46.

ARTICULATION, in botany, is the connection of parts that consist of joints or knees, such as the pods of French honey-suckles, which when ripe divide into so many parts as there are knees or joints; also those parts of plants which swell into nodes or joints; and which usually send forth branches.

ARTIFICER, a person whose employment it is to manufacture any kind of commodity, as in iron, brass, wool, &c. such are smiths, braziers, carpenters, &c. The Roman artificers had their peculiar temples, where they assembled and chose their own patron, to defend their causes: they were exempted from all personal services. Taruntenus Paternus reckons 32 species of artificers, and Constantine 35, who enjoyed this privilege. The artificers were incorporated into divers colleges or companies, each of which had their tutelar gods, to whom they offered their worship. Several of these, when they quitted their profession, hung up their tools, a votive offering to their gods. Artificers were held a degree below merchants, and *argentarii* or money-changers, and their employment more sordid. Some deny, that in the earliest ages of the Roman state artificers were ranked in the number of citizens: others, who assert their citizenship, allow that they were held in contempt, as being unfit for war, and so poor that they could scarce pay any taxes. For which reason they were not entered among the citizens in the censor's books; the design of the census being only to see what number of persons were yearly fit to bear arms, and to pay taxes towards the support of the state. It may be added, that much of the artificers business was done by slaves and foreigners, who left little for the Romans to mind but their husbandry and war. By means of the arts, the minds of men are engaged in inventions beneficial to the whole community; and thus prove the grand preservative against the barbarism and brutality, which ever attend on an indolent and inactive stupidity.

By the English laws, artificers in wool, iron, steel, brass, or other metal, going out of the kingdom into any foreign country without licence, are to be imprisoned three months, and fined in a sum not exceeding one hundred pounds. And such as going abroad, and not returning on warning given by ambassadors, &c. shall be disabled from holding lands by descent or devise, from receiving any legacy, &c. and be deemed aliens. Stat. 5. Geo. I. cap. 27. By 23 Geo. II. cap. 13. § 1. penalty is also inflicted on seducing artificers to go abroad. Ramazini has a treatise on the diseases of artificers.

ARTIFICIAL, in a general sense, denotes something made, fashioned, or produced by art, in contradistinction from the productions of nature.

ARTIFICIAL is also frequently used for factitious. Thus we have artificial sal ammoniac, artificial borax, &c.

ARTIFICIAL Fire-works are compositions of inflammable materials, chiefly used on solemn occasions, by way of rejoicing. See PYROTECHNY.

ARTIFICIAL Lightening. See ELECTRICITY and LIGHTNING.

ARTIFICIAL Lines, on a sector or scale are certain lines so contrived, as to represent the logarithmic sines and tangents; which, by the help of the line of numbers, will solve all questions in trigonometry, navigation, &c. pretty exactly.

ARTIFICIAL Magnets. See MAGNETS.

ARTIGI, indeclinable, (Pliny); *Artigis*, (Ptolemy); a town of the Turduli, in Bætica. Now *Alhama*.

ARTILLERY, in its general sense, denotes the offensive apparatus of war, particularly of the missile kind. Among the French the term was anciently appropriated to ARCHERY. In its modern acceptation it signifies fire-arms, mounted on their carriages and ready for action, with their balls, their bombs, their grenades, &c.

If we take the term in a more extensive meaning, it includes the powder, the matches, instruments for fireworks, the utensils of ordnance, the machines which facilitate their motion and transport them, the vehicles over which they traverse rivers, every thing necessary to them, and all that enters into the form of a train of artillery.

The same word, still farther extended in its meaning, likewise comprehends the men destined for the service of the *artillery*; the people who provide the artillery with materials and implements when engaged, the cannoniers, the bombardiers, the officers of every rank, and engineers of every kind.

By *artillery* is likewise understood the science which the officers of artillery ought to possess. This science teaches to know the nature of all the materials and ingredients which enter into the composition and the structure of every thing relative to the artillery, such as nitre, sulphur, charcoal: the properties of air and fire;

Artillery. fire; the compoſition and preparation of gun-powder; the materials for fire-works; the conſtruction, proportions, &c. of the different warlike machines; the arrangement, movement, and whole management, of cannon, &c. in the field or in ſieges, in ſuch a manner, that each of them, according to the length of its tube, and the diameter of its bore, may be ſituated in the beſt place and at the propereſt diſtance for execution, and that the whole train taken together may reciprocally aſſiſt and ſupport each other with the greateſt advantage.

Artillery has undergone many changes from its origin to the preſent time. The artillery of the ancients were the catapulta, the baliſtæ, the different kinds of ſlings, &c. In latter ages, the Franks uſed the hatchet as a miſſile weapon, throwing it in the ſame manner as the Americans do theirs, called the *tomahawk*. The Gaſcons and Genoeſe were excellent croſs-bow-men. The Swiſs owed their victories to their ſtrength and ſkill in the uſe of the pike, halberd, and eſpadon or two-handed ſword; and the victories of Creſſy, Poictiers, and Agincourt, will occaſion the valour and ſkill of the Engliſh archers to be tranſmitted down to lateſt poſterity. See ARCHERY.

The chevalier Folard was extremely attached to the ancient machines firſt mentioned, and ſeemed even to prefer them to our fire-arms: an opinion which muſt appear not a little extraordinary from ſuch a perſon. Father Daniel might well be miſtaken in the compariſon which he made between the effects of ancient and modern artillery, and in his concluſion that the latter was of little uſe: the ſituation of this good father removed him from the ſcenes of war and the opportunities of military experience. But it is aſtoniſhing, that one ſo learned in the military art as the commentator of Polybius, who had ocular demonſtration of the ſucceſs of modern artillery, ſhould have declared ſo violently againſt it. Whatever be the caſe with theſe authors and their maxims, it may be aſſerted, that cannon is one of the moſt ſingular diſcoveries which have been made amongſt men; and by little and little it has changed the whole art of war, and of conſequence influenced the whole ſyſtem of policy, in Europe. The æra of artillery is dated from the battle of Creſſy in 1346, becauſe it is only from that day that cannons were mentioned in battle. Edward III. of England ſucceſsfully employed ſome pieces of artillery placed in the front of his army. The invention of artillery was then known in France as well as in England; but probably Philip VI. marched with ſo much hurry and precipitation to attack his enemy, that he left his cannon as uſeleſs incumbrances behind him. The ignorance of that age in mechanical arts conſiderably retarded the progreſs of artillery; and that of which they were then poſſeſſed was ſo unwieldy and imperfect, that they could not poſſibly diſcern its importance and efficacy in practice.

After the invention of gun-powder, the Spaniards were the firſt who armed part of their foot with muſkets and harquebuſſes, and mixed them with the pikes. In this they were ſoon imitated by moſt other nations; though the Engliſh had not entirely laid aſide their favourite weapon the long-bow, and generally taken to the uſe of fire arms, during the reign of queen Elizabeth.

The firſt muſkets were very heavy, and could not be fired without a reſt: they had matchlocks, and barrels of a wide bore, that carried a large ball and charge of powder, and did execution at a great diſtance. The muſketeers on a march carried only their reſts and ammunition, and had boys to bear their muſkets after them, for which they were allowed great additional pay. They were very ſlow in loading, not only by reaſon of the unwieldineſs of the pieces, and becauſe they carried the powder and balls ſeparate, but from the time it took to prepare and adjuſt the match; ſo that their fire was not near ſo briſk as ours is now. Afterwards a lighter kind of matchlock-muſket came into uſe; and they carried their ammunition in bandeliers, which were broad belts that came over the ſhoulder, to which were hung ſeveral little caſes of wood covered with leather, each containing a charge of powder; the balls they carried looſe in a pouch, and they had alſo a priming-horn hanging by their ſide. Matchlocks were, about the beginning of this century, univerſally diſuſed in Europe, and the troops were armed with firelocks; to which, much about the ſame time, the bayonet being added, pikes alſo were laid aſide; which latter change, whether it was for the better or not, is a point that ſtill admits of diſpute among the beſt military writers, who are divided in their opinions about it, though moſt of them diſapprove of it.

The old Engliſh writers call thoſe large muſkets *calivers;* the harquebuſs was a lighter piece, that could be fired without a reſt. The matchlock was fired by a match, fixed by a kind of tongs in the ſerpentine or cock, which by pulling the trigger was brought down with great quickneſs upon the priming in the pan, over which there was a ſliding cover, which was drawn back by hand, juſt at the time of firing. There was a great deal of nicety and care required to fit the match properly to the cock, ſo as to come down exactly true on the priming, to blow the aſhes from the coal, and to guard the pan from the ſparks that fell from it: a great deal of time was alſo loſt in taking it out of the cock, and returning it between the fingers of the left-hand, every time that the piece was fired; and wet weather often rendered the matches uſeleſs. However, moſt writers allow that they were very ſure, and leſs apt to miſs fire than the firelock.

The firelock is ſo called, from producing fire of itſelf, by the action of the flint and ſteel. The moſt ancient invention of this ſort is the wheel-lock, which we find mentioned in Luigi Collado's Treatiſe of Artillery, printed at Venice, 1586, as then lately invented in Germany. This ſort of lock was uſed till within theſe hundred years, eſpecially for piſtols and carbines. It was compoſed of a ſolid ſteel wheel, with an axis, to which was faſtened a chain, which, by being round it, drew up a very ſtrong ſpring; on pulling the trigger, the ſpring acting, whirled about the wheel with great velocity, and the friction of the edge of it (which was a little notched) againſt the ſtone produced the fire: the cock was made ſo as to bring the ſtone upon the edge of the wheel, part of which was in the pan, and touched the priming; they uſed any common hard pebble for that purpoſe, which ſerved as well as flint.

Theſe locks were inconvenient, took time to wind up (or ſpan, as they termed it), and ſometimes would not go off; an inſtance of which may be ſeen in Ludlow's Memoirs.

When

When the firelock, such as we now use, was invented, we cannot ascertain: it is called, by writers of about the middle of the last century, a *snaphane* or *snaphance*; which being the Dutch word for a *firelock*, seems to indicate that it is a Dutch invention, and that we took it from them. But Ward, in his Animadversions of War, printed in 1639, p. 502, after describing the exercise of the firelock, pistol, and carbine (by which he means the wheel-lock), says, that as most of our pieces go with English locks, which differ from firelocks, he shall add the method of handling them; and then gives the exercise of the snaphine carbine; by which it appears, that there was little or no difference between that and the pieces now in use. The more modern writers call it a *fusee*, from the French word *fusil*; whence the name of fusileers is still continued to several regiments, which were the first that were armed with them on the disuse of matchlocks.

They used the musket and rest in England so late as the beginning of the civil wars, as may be seen in Col. Bariffe's Young Artillery Man, printed at London, 1643.

Figuerra, in his embassy in 1518, relates, that the Persians would neither make use of infantry nor of artillery, because by them the impetuosity of attack, and the facility of retreat were equally incumbered and retarded: in these expedients alone their address and their glory consisted. This method of advancing and recalling is widely different from the present conduct of war, as the artillery in armies is now prodigiously multiplied, and must be transported to every place where any body of troops whatever is destined to operate.

The length and diameter of cannon has been much diminished, which must likewise proportionably diminish their weight. It is by long practice and experience that they have discovered how much might be deduced from their magnitude in both these respects with propriety, without hurting the grand effects which, on some occasions, it is necessary they should produce, by rendering them more easy to be wielded, which was the advantage pursued by lessening their size. See further the articles CANNON, GUNNERY, and PROJECTILES.

Improvements, however, are still making, and will probably long continue to be made, in these ignivomous machines that mock the thunder, which, though they seem to be invented for the destruction of the human race, and the subversion of empires, have yet by their effects rendered war less savage and less sanguine; political alliances have been more successfully conciliated among all nations, conquests are become less frequent and less rapid, and successes in war have been more easily reduced to calculation.

Wealth of Nations, Philad. edit vol. iii. 65.

The change introduced into the military art by the modern artillery, Dr Smith observes, has enhanced greatly both the expence of exercising and disciplining any particular number of soldiers in time of peace, and that of employing them in time of war. Both their arms and their ammunition are become more expensive. A musket is a more expensive machine than a javelin or a bow and arrows; a cannon or a mortar, than a balista or a catapulta. The powder which is spent in a modern review is lost irrecoverably and occasions a very considerable expence. The javelins and arrows which were thrown or shot in an ancient one, could easily be picked up again, and were besides of very little value. The cannon and the mortar are not only much dearer, but much heavier machines than the balista or catapulta, and require a greater expence, not only to prepare them for the field, but to carry them to it. As the superiority of the modern artillery too over that of the ancients is very great, it has become much more difficult, and consequently much more expensive, to fortify a town so as to resist even for a few weeks the attack of that superior artillery.

In modern war the great expence of fire-arms gives an evident advantage to the nation which can best afford that expence; and consequently, to an opulent and civilized, over a poor and barbarous nation. In ancient times, the opulent and civilized found it difficult to defend themselves against the poor and barbarous nations. In modern times the poor and barbarous find it difficult to defend themselves against the opulent and civilized. The invention of fire-arms, an invention which at first sight appears to be so pernicious, is certainly favourable both to the permanency and to the extension of civilization.

It has to many appeared matter of surprise, that the battles of the ancients should be described with an order, perspicuity, and circumstantial minuteness, which are not to be found in the military writers of modern times. Scholars have endeavoured to explain this difference, by observing the immense disproportion, in point of dignity and abilities, between the military historians of modern Europe and those of Greece and Rome. But the difficulty will be better solved, Dr Gillies thinks, by reflecting on the changes introduced into the art of war by the change of artillery; which, in military operations, form the pivot on which the whole turns. 1. From the nature of fire-arms, modern battles are involved in smoke and confusion. 2. From the same cause, modern armies occupy a much greater extent of ground, and begin to act at much greater distances; which renders it more difficult to observe and ascertain their manœuvres. 3. The immense train of artillery, ammunition, &c. required in the practice of modern war, gives a certain immobility to our armies which renders it impossible to perform, without great danger, those rapid evolutious in sight of an enemy, which so often decided the battles of the ancients. With us almost every thing depends on the judicious choice of ground, a matter requiring greater military genius, but not admitting the embellishments of historical description.

In the battles of the Greeks and Romans, the extraordinary disproportion between the numbers slain on the side of the victors and the vanquished, has been observed as another remarkable circumstance. But this necessarily resulted from the nature of their arms. Their principal weapons being not missile, but manual, armies could not begin to act till they had approached so nearly to each other, that the conquered found themselves cut off from all possibility of retreat. In modern times, such consequences seldom take place. The use of fire-arms (which often renders the action itself more bloody) furnishes the defeated party with various means of retreating with considerable safety. The sphere of military action is so widely extended in modern times, that before the victors can run over the space which separates

Artillery, Artobriga.

parates them from the vanquished, the latter may fall back, and proceed with little loss beyond their reach; and should any village, hedge, ravine, &c. be found in their way may often check the ardour of the pursuers. Upon these considerations, the invention of gun-powder and modern artillery may be said to have saved the effusion of human blood. Equestrian engagements (since the principles on which cavalry act remain nearly the same in every age) are still distinguished by similar circumstances to those which appear so extraordinary in the battles of antiquity.

Artillery-Park, the place in the rear of both lines in the army; for encamping the artillery, which is drawn up in lines, of which one is formed by the guns; the ammunition waggons make two or three lines, 60 paces behind the guns, and 30 distant from one another; the pontoons and tumbrils make the last line. The whole is surrounded with a rope which forms the park: the gunners and matrosses encamp on the flanks; and the bombardiers, pontoonmen, and artificers, in the rear.

Artillery-Train, a certain number of pieces of ordnance, mounted on carriages, with all their furniture fit for marching.

ARTIST, in a general sense, a person skilled in some art. Mr Harris defines an artist to be, "A person possessing an habitual power of becoming the cause of some effect, according to a system of various and well-approved precepts." See Art.

*Evel, Discourse of Medals, p. 237, &c.

We are told* of a privilege granted at Vicenza to artists, like that of *clergy* in England: in virtue thereof, criminals adjudged to death save their lives if they can prove themselves the most excellent and consummate workmen in any useful art. This benefit is allowed them *in favorem artis*, for the first offence, except in some particular crimes, of which coining is one; for here the greater the artist, the more dangerous the person.

Artist *(Artista)*, in an academical sense, denotes a philosopher or proficient in the faculty of arts.

In the early ages of universities, the seven liberal arts completed the whole course of study, or philosophy, as it was called; whence the masters of this faculty were denominated *Artists*. What they understood by the liberal arts used to be summed up in the following Latin verse:

Lingua, Tropus, Ratio, Numerus, Tonus, Angulus Astra.

Artist is more peculiarly used by Paracelsus and other adepts, for a chemist or alchemist. We find frequent mention, in authors of this class, of Elias Artista, or Elias the artist, who is to come some time before the dissolution of the world, and restore and make perfect all arts and sciences, but especially the gold-making art; and usher in a truly golden age, or millennium. The lower and meaner things in this sublime art, Paracelsus observes, God has permitted to be already discovered; but for the greater and more important matters, as the transmutation of other metals into gold, they are reserved to the coming of Elias the artist.

ARTOBRIGA, a town of Vindelicia (Ptolemy): Now *Altzburg*, in Bavaria, on the Danube, below Ingolstadt (Aventinus); but Cluverius supposes it to be *Lebenau*, on the Saltzbach, below Lauffen, in the archbishopric of Saltzburg.

Artocarpus

ARTOCARPUS (from αρτος, *bread*, and καρπος, *fruit*), the Bread-fruit Tree: A genus of the monandria order, belonging to the monœcia class of plants. It has a cylindric amentum or catkin, which thickens gradually, and is covered with flowers; the male and female in different amentum. In the *male*, the calyx is two-valved, and the corolla is wanting. In the *female*, there is no calyx or corolla; the stylus is one, and the drupa is many-celled.

Though this tree has been mentioned by many voyagers, particularly Dampier, by Rumphius, and by Lord Anson, yet very little notice seems to have been taken of it till the return of Captain Wallace from the South Seas, and since that time by others who have touched at Otaheite and some countries in the East Indies. Captain Dampier relates, that in Guam, one of the Ladrone islands, "there is a certain fruit called the *bread-fruit*, growing on a tree as big as our large apple-trees, with dark leaves. The fruit is round, and grows on the boughs like apples, of the bigness of a good penny loaf: when ripe, it turns yellow, soft, and sweet; but the natives take it green, and bake it in an oven till the rind is black: this they scrape off, and eat the inside, which is soft and white, like the inside of new-baked bread, having neither seed nor stone; but if it is kept above 24 hours it is harsh. As this fruit is in season eight months in the year, the natives feed upon no other sort of bread during that time. They told us that all the Ladrone islands had plenty of it. I never heard of it in any other place."

Rumphius, after describing the tree, observes, that "the fruit is shaped like a heart, and increases to the size of a child's head. Its surface or rind is thick, green, and covered every where with warts of a quadragonal or hexagonal figure, like cut diamonds, but without points. The more flat and smooth these warts are, the fewer seeds are contained in the fruit, and the greater is the quantity of pith, and that of a more glutinous nature. The internal part of the rind, or peel consists of a fleshy substance, full of twisted fibres, which have the appearance of fine wool; these adhere to, and in some measure form it. The fleshy part of this fruit becomes softer towards the middle, where there is a small cavity formed without any nuts or seeds, except in one species, which has but a small number, and this sort is not good unless it is baked, or prepared some other way: but if the outward rind be taken off, and the fibrous flesh dried and afterwards boiled with meat as we do cabbage, it has then the taste of artichoke bottoms. The inhabitants of Amboyna dress it in the liquor of cocoa-nuts: but they prefer it roasted on coals till the outward part or peel is burnt. They afterwards cut it into pieces, and eat it with the milk of the cocoa-nut. Some people make fritters of it, or fry it in oil; and others, as the Sumatrians, dry the internal soft part, and keep it to use instead of bread with other food. It affords a great deal of nourishment, and is very satisfying, therefore proper for hard-working people; and being of a gentle astringent quality, is good for persons of a laxative habit of body.

It

Artocarpus Artois.

It is more nourishing boiled in our manner with fat meat than roasted on coals. The milky juice which distils from the trunk, boiled with the cocoa-nut oil, makes a very strong bird-lime. This tree is to be found on the eastern parts of Sumatra, and in the Malay language is called *soccus* and *soccum capas*. It grows likewise about the town of Bantam in Java, and in Balega and Madura, and is known there by the name of *soccum*."

In Anson's voyage we are informed, "that the rima, or bread-fruit tree, is common in all the Ladrone islands and some of the Philipines. It is somewhat larger than our apple-tree, and bears a broad dark-coloured leaf with five indentures on each side. The fruit hangs on boughs like apples; and is of the size of a penny loaf, with a thick tough rind, which when full ripe turns yellow. The natives gather it before it is quite ripe, and bake it till the crust is pretty black; then they rasp it, and there remains a pretty loaf, with a tender yellow crust, and the crumb of it is soft and sweet as a new-baked roll: it is without any seeds or stones. This fruit the inhabitants enjoy for about seven months; during which they never eat any other kind of bread: but they are obliged to bake it every day; for when it grows a little stale, it becomes harsh and husky, somewhat like the potatoe-bread made in the west of England. There is, however, a remedy for this; which is cutting the loaf into slices when it is new, and drying it in the sun, by which it is changed into the pleasantest rusk that can be eaten."

Captain Cook, in his voyage, observes, that this fruit not only serves as a substitute for bread among the inhabitants of Otaheite * and the neighbouring islands, but also, variously dressed, composes the principal part of their food. It grows on a tree that is about the size of a middling oak; its leaves are frequently a foot and an half long, of an oblong shape, deeply sinuated like those of the fig-tree, which they resemble in colour and consistence, and in the exsuding of a milky juice upon being broken. The fruit is about the size and shape of a new-born child's head; and the surface is reticulated †, not much unlike a truffle; it is covered with a thin skin, and has a core about as big as the handle of a small knife. The eatable part lies between the skin and the core; it is as white as snow, and somewhat of the consistence of new bread; it must be roasted before it is eaten, being first divided into three or four parts; its taste is insipid, with a slight sweetness somewhat resembling that of the crumb of wheaten bread mixed with a Jerusalem artichoke. This fruit is also cooked in a kind of oven, which renders it soft, and something like a boiled potatoe; not quite so farinaceous as a good one, but more so than those of the middling sort. Of the bread-fruit they also make three dishes, by putting either water or the milk of the cocoa-nut to it, then beating it to a paste with a stone pestle, and afterwards mixing it with ripe plantains, bananas, or the sour paste which they call *mahie*.

* *Hawkesworth's account of Captain Cooke's voyage.*

† Plate LVIII.

The mahie, which is likewise made to serve as a succedaneum for ripe bread-fruit before the season comes on, is thus made: The fruit of the bread-tree is gathered just before it is perfectly ripe; and being laid in heaps, is closely covered with leaves: in this state it undergoes a fermentation, and becomes disagreeably sweet; the core is then taken out entire, which is done by gently pulling out the stalk, and the rest of the fruit is thrown into a hole which is dug for that purpose generally in the houses, and neatly lined in the bottom and sides with grass: the whole is then covered with leaves and heavy stones laid upon them; in this state it undergoes a second fermentation, and becomes sour, after which it will suffer no change for many months. It is taken out of the hole as it is wanted for use; and being made into balls, it is wrapped up in leaves and baked: after it is dressed, it will keep five or six weeks. It is eaten both cold and hot; and the natives seldom make a meal without it, though to Europeans the taste is as disagreeable as that of a pickled olive generally is the first time it is eaten. The fruit itself is in season eight months in the year, and the mahie supplies the inhabitants during the other four.

To procure this principal article of their food (the bread-fruit), costs these happy people no trouble or labour except climbing up a tree: the tree which produces it does not indeed grow spontaneously; but if a man plants ten of them in his life-time, which he may do in about an hour, he will as completely fulfil his duty to his own and future generations, as the native of our less temperate climate can do by ploughing in the cold of winter, and reaping in the summer's heat, as often as these seasons return; even if, after he has procured bread for his present household, he should convert a surplus into money, and lay it up for his children.

There are two species of artocarpus, viz. the incisus, with gashed leaves; and the integrifolia, with entire leaves. There is also said to be another distinction, into that which bears fruit with stones or seeds, and that in which the fruit has none. The parts of fructification of that tree which bears the fruit without stones are defective. The amentum, or catkin, which contains the male parts, never expands. The styli, or female part of the fruit, are likewise deficient. From which it follows, that there can be no stones or seeds, and therefore that this tree can be propagated only by suckers or layers; although it is abundantly evident, that it must originally have proceeded from the seed-bearing bread-fruit tree. Instances of this kind we sometimes find in European fruits; such as the barberry, and the Corinthian grape from Zant commonly called currants, which can therefore be increased only by layers and cuttings. Dr Solander was assured by the oldest inhabitants of Otaheite and the adjoining islands, that they well remember there was formerly plenty of the seed-bearing bread-fruit; but they had been neglected upon account of the preference given to the bread-fruit without seeds, which they propagate by suckers.

ARTOIS, a province of France, and one of the finest and most fertile in the whole kingdom; formerly it was one of the 17 provinces of the Netherlands, but now belongs entirely to France. The names of *Artois*, and *Arras* its capital, are derived from the Atrebates, a people of Gallia Belgica, mentioned by Julius Cæsar. Its greatest length from north to south is about 24 leagues, and its breadth about 12, being bounded to the south and west by Picardy, to the east by Hainault, and to the north by Flanders. A considerable trade is carried on in the province in grain, flax, hops, wool, and linen cloth. The states, who meet regularly once a-year, consist of the clergy, nobility, and commoners; and sit generally a fortnight at Arras: their chief business is to deliberate on the ways and means to raise the money which the king demands of them, and which usually amounts to about 400,000 livres, exclusive of forage-money. The most considerable places in Artois are, Arras the capital, Bapaume, Bethune, St Venant, and St Omer.

ARTOLICA (anc. geog.), a town of the Salassii, in Gallia Cispadana, (Antonine); at the foot of the Alps: now called *la Tuile* by the inhabitants, a hamlet of Savoy, in the duchy of Aoust, at the foot of mount St Bernard the Less.

ARTOTYRITES, a Christian sect, in the primitive church, who celebrated the eucharist with bread and cheese, saying, that the first oblations of men were not only of the fruit of the earth, but of their flocks. The word is derived from αρτος, *bread*, and τυρος, *cheese*.

The Artotyrites admitted women to the priesthood and episcopacy; and Epiphanius tells us, it was a common thing to see seven girls at once enter into their church, robed in white, and holding a torch in their hand; where they wept, and bewailed the wretchedness of human nature, and the miseries of this life.

ARUA (anc. geog.), a town of Bætica, of the resort of the Conventus Hispalensis, (Pliny): now *Alcclea*, a citadel of Andalusia, on the Bætis, or Guadalquiver, seven leagues above Seville.

ARVALES FRATRES, in Roman antiquity, a college of 12 priests, instituted by Romulus, and chosen out of the most noble families, himself being one of that body: they assisted in the sacrifices of the ambervalia annually offered to Ceres and Bacchus, for the prosperity of the fruits of the earth; when they wore on their heads crowns made of ears of corn.—The original of this institution was as follows: Acca Laurentia, Romulus's nurse, was accustomed once a-year to make a solemn sacrifice for a blessing on the fields, her 12 sons always assisting her in the solemnity; but at last losing one of her sons, Romulus offered himself to supply his place, and gave this small society the name of *Arvales fratres*. This order was in great repute at Rome; they held the dignity for life, and never lost it upon account of imprisonment, banishment, or any other accident.

ARUBA, a small island on the coast of Terra Firma, subject to the Dutch, and situated in W. Long. 69. 30. N. Lat. 12. 30.

ARUCI (anc. geog.), a town of the Celtici, in the north of Lusitania, (Antonine, inscription); called also *Aruci Novem*, to distinguish it from the following: Now supposed to be *Moura*, a small city of Portugal, near the confluence of the Ardila and Guadalquiver.

ARUCI VETUS (anc. geog.), a small city of the Turdetani, in Bætica, (Ptolemy); now *Aroche*, a hamlet of Andalusia, on the confines of Portugal and Estramadura, on the river Gama, seven leagues to the east of Aruci Novum or Moura. From it a mountain, in its neighbourhood, takes the name *Arucitanus*. Now *la Sierra de Aroche*.

ARUCIA (anc. geog.), a town of Illyria, in the inland part of Liburnia, (Ptolemy): Now *Bregna*; according to some; but *Ottoschatz*, according to others; a citadel of Morlachia.

ARVERNI, an appellation early used for the capital of the Arverni, according to the custom of the latter ages of naming towns from the people; it was formerly called *Nemossus*, (Strabo). The *Arverni*, a brave and ancient people, and one of the most powerful nations of Gaul, claimed affinity with the Romans, as descendants from Antenor, (Lucan): and after their conquest by the Romans, their ancient liberty was preserved to them on account of their bravery, (Pliny). Above 1000 years ago the town was called *Clarus Mons*, from its situation, (Valesius.) Now *Clermont*, in Auvergne, E. Long. 3. 20. N. Lat. 45. 42.

ARVIL-SUPPER, a feast or entertainment made at funerals, in the north part of England. Arvil-bread is the bread delivered to the poor at funeral solemnities: and *arvil*, *arval*, *arfal*, are used for the burial or funeral rites, as,

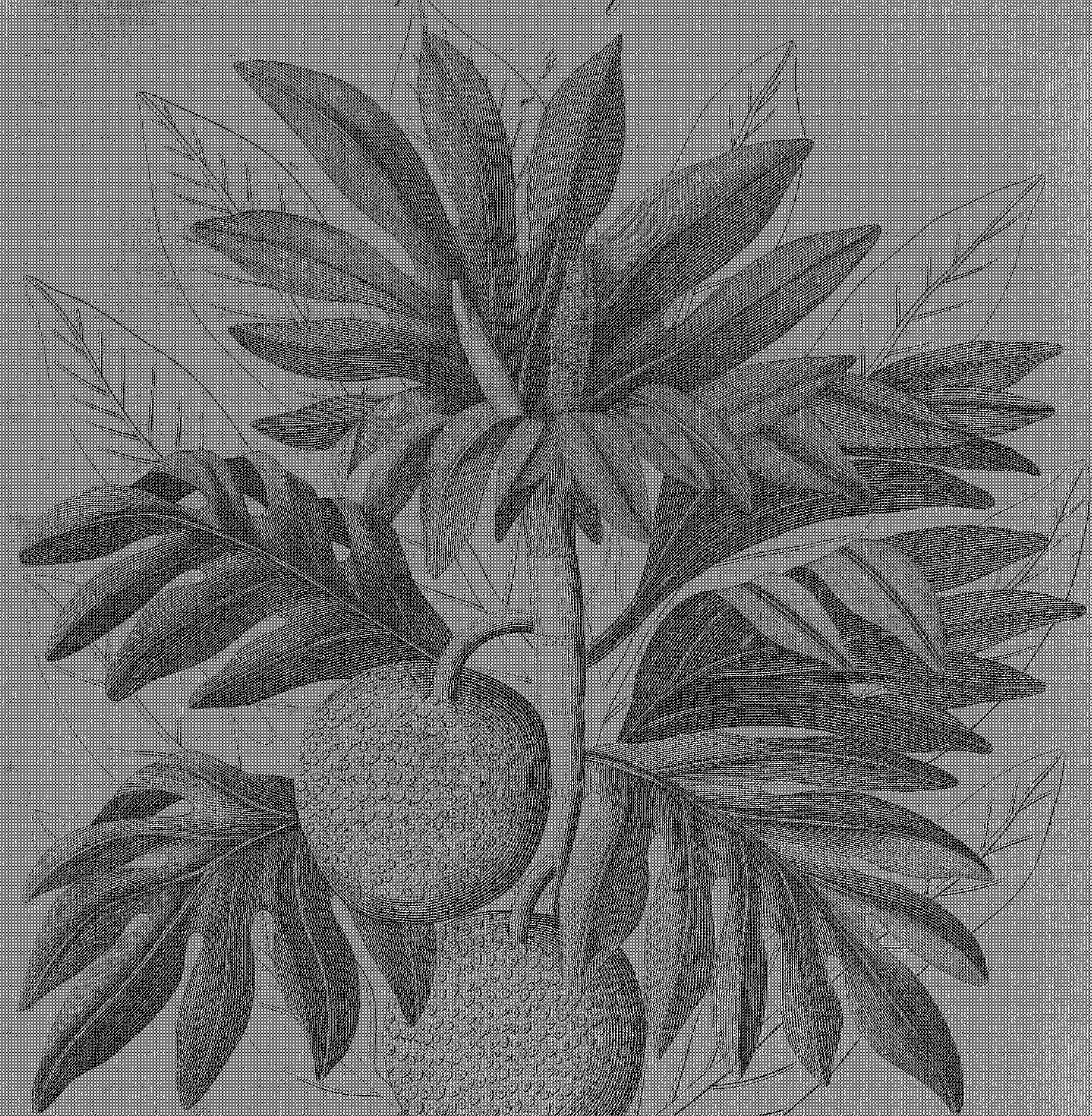
> Come, bring my jerkin, Tibb, I'll to the *arvil*;
> Yon man's dea scuy seoun, it makes me marvil.
>
> *Yorksh. Dial.* p. 58.

ARVIRAGUS, an ancient British king who flourished in the time of the emperor Domitian. He gained a complete victory over Claudius: but being soon after besieged in the city of Winchester, he made a treaty with the Romans, and married the emperor's daughter Genuissa. This monarch lived to a good old age: he confirmed the ancient laws, enacted new ones, and liberally rewarded persons of merit.

ARUM, WAKEROBIN, or CUCKOW-PINT: A genus of the polyandria order, belonging to the gynandria class of plants; and in the natural method ranking under the 2d order, *Piperitæ*. The spatha is monophyllous, and cowl-shaped; the spadix is naked above, female below, and stamen'd in the middle.—The

Species are 22; of which the most remarkable are the following. 1. The maculatum, or common wakerobin, grows naturally in woods and on shady banks in most parts of Britain. The leaves are halberd-shaped, very entire, and spotted; the berries numerous, growing in a naked cluster. The flowers appear in April; and their wonderful structure hath given rise to many disputes among the botanists. The receptacle is long, in the shape of a club, with the seed-buds surrounding its base. The chives are fixed to the receptacle amongst the seed-buds, so that there is no occasion for the tips to be supported upon threads, and therefore they have none; but they are fixed to the fruit-stalk, and placed between two rows of tendrils: the point in dispute is what is the use of those tendrils? 2. The proboscidium. 3. The arisarum. 4. The tenuifolium. These three species have usually been separated from this genus, and distinguished by the general name of *arisarum*, or *friar's cowl*, on account of the resemblance of their flowers to the shape of the cowls worn by friars. The flowers appear in April. 5. The italicum, is a native of Italy, Spain, and Portugal. The leaves rise a foot and an half high, terminating in a point; they are very large, and finely veined with white, interspersed with black spots, which, together with the fine shining green, make a pretty variety. The flowers grow near a foot high;

Artocarpus The Bread fruit Tree Plate LVIII



and have very long upright ſpathas, which are of a pale green. They appear in the end of April, or beginning of May. 6. The dracunculus, or common dragons, grows naturally in moſt of the ſouthern parts of Europe. It hath a ſtraight ſtalk three or four feet high, which is ſpotted like the belly of a ſnake: at the top it is ſpread out into leaves, which are cut into ſeveral narrow ſegments almoſt to the bottom, and are ſpread open like a hand; at the top of the ſtalk the flower is produced, which is in ſhape like the common arum, having a long ſpatha of a dark purple colour, ſtanding erect, with a large piſtil of the ſame colour, ſo that when it is in flower it makes no unpleaſing appearance; but the flower hath ſo ſtrong a ſcent of carrion, that few people can endure it, for which reaſon it hath been baniſhed moſt gardens. 7. The trilobatum, or arum of Ceylon, is a native of that iſland and ſome other parts of India; ſo is very impatient of cold. It is a low plant; the flower riſes immediately from the root, ſtanding on a very ſhort footſtalk: the ſpatha is long, erect, and of a fine ſcarlet colour, as is alſo the piſtil. 8. The colocaſia. 9. The divaricatum, with ſpear-ſhaped leaves. 10. The peregrinum, or elder. 11. The eſculentum, or eatable arum. 12. The ſagittifolium, or greateſt Egyptian arum. All theſe ſpecies have mild roots, which are eaten by the inhabitants of the hot countries, where they grow naturally; and ſome of them are cultivated by the inhabitants of the ſugar colonies, where their roots are conſtantly eaten, as alſo the leaves of ſome of them, particularly thoſe of the eſculentum, which they call *Indian kale;* and which, in thoſe countries where many of the eſculent vegetables of England are with difficulty produced, proves a good ſuccedaneum. 13. The arboreſcens, or dumb cane, is a native of the ſugar iſlands and warm parts of America, where it grows chiefly on low grounds. All the parts of it abound with an acrid juice; ſo that if a leaf or part of the ſtalk is broken and applied to the tip of the tongue, it occaſions a very painful ſenſation and a great defluxion of ſaliva. The ſtalks of this plant are ſometimes applid to the mouths of the negroes by way of puniſhment.

Culture. All the ſpecies of this plant are hardy, except the trilobatum and the arboreſcens. The former muſt be kept conſtantly in a ſtove, and the laſt in a moderate hot-bed. The arboreſcens is propagated by cutting off the ſtalks into lengths of three or four joints, which muſt be left to dry ſix weeks or two months; for if the wounded part is not perfectly healed over before the cuttings are planted, they will rot and decay. They are then to be planted in ſmall pots filled with light ſandy earth, and plunged in a moderate hot-bed of tan, obſerving to let them have little water till they have taken good root.

Medicinal Uſes. The roots of the maculatum and dracunculus are uſed in medicine, and differ in nothing but that the latter is ſomewhat ſtronger than the former. All the parts of the arum, particularly the root, have an extremely pungent, acrimonious taſte; if the root be but lightly chewed, it continues to burn and vellicate the tongue for ſome hours, occaſioning at the ſame time a conſiderable thirſt: theſe ſymptoms are alleviated by butter, milk, or oily liquors. Dried and kept for ſome time, it loſes much of its acrimony, and becomes at length an almoſt inſipid farinaceous ſubſtance.

This root is a powerful ſtimulant and attenuant. It is reckoned a medicine of great efficacy in ſome cachectic and chlorotic caſes, in weakneſs of the ſtomach occaſioned by a load of viſcid phlegm. Great benefit has been obtained from it in rheumatic pains, particularly thoſe of the fixed kind, and which were ſeated deep. In theſe caſes it may given from ten grains to a ſcruple of the freſh root twice or thrice a-day, made into a bolus or emulſion with unctuous and mucilaginous ſubſtances, which cover its pungency, and prevent its making any painful impreſſion on the tongue. It generally excites a ſlight tingling ſenſation through the whole habit, and, when the patient is kept warm in bed, produces a copious ſweat.

The arum was formerly an ingredient in an officinal preparation, the compound powder; but in that form its virtues are very precarious. Some recommended a tincture of it drawn with wine; but neither wine, water, nor ſpirits, extract its virtues.

ARUNDA, a town of Hiſpania Bætica, on the Annas, or Guadiana, (Ptolemy, Pliny): Now ſaid to be *Ronda,* in the province of Granada, on the confines of Andaluſia. W. Long. 5. 40. Lat. 36. 26.

ARUNDEL (Thomas), archbiſhop of Canterbury in the reign of Richard II. Henry IV. and Henry V. He was the ſecond ſon of Robert Earl of Arundel and Warren, and brother of Richard Earl of Arundel who was beheaded. At 22 years of age, from being archdeacon of Taunton he was raiſed to the biſhopric of Ely, the 6th of April 1375, in the reign of Edward III. He was a great benefactor to the church and palace of this ſee; among other donations he gave a curious table of maſſy gold, adorned with precious ſtones, which had been given to prince Edward by the king of Spain, and ſold by the latter to Biſhop Arundel. In 1386, he was appointed lord chancellor of England; two years after, he was tranſlated to the ſee of York; and, in 1316, was advanced to the archipiſcopal ſee of Canterbury, when he reſigned the chancellorſhip. This was the firſt inſtance of the tranſlation of an archbiſhop of York to the ſee of Canterbury. Scarcely was he fixed in this ſee, when he had a conteſt with the univerſity of Oxford about the right of viſitation. The affair was referred to king Richard, who determined it in favour of the archbiſhop. At his viſitation in London, he revived an old conſtitution, by which the inhabitants of the reſpective pariſhes were obliged to pay to their rector one-half-penny in the pound out of the rent of their houſes. In the ſecond year of his tranſlation, a parliament being held at London, the commons with the king's leave impeached the archbiſhop, together with his brother the earl of Arundel, and the Duke of Gloceſter, of high treaſon. The archbiſhop was ſentenced to be baniſhed, and within forty days to depart the kingdom on pain of death. He retired firſt to France; and then to the court of Rome, where Pope Boniface IX. gave him a kind reception. About this time the Duke of Lancaſter (afterwards Henry IV.) was in France, having been baniſhed by king Richard. The nobility and others, tired with the oppreſſions of Richard, ſolicited the Duke to take the crown. This their requeſt they drew up in a

Arundel. letter, and sent it over by faithful messengers to archbishop Arundel, desiring him to be their advocate on this occasion with the Duke. The archbishop, being a fellow-sufferer, gladly accepted the office; and went with the messengers to the Duke at Paris, where they delivered the letters from the nobles and commons of England, and the archbishop seconded them with the best arguments he could invent. The inviting offer, after some objections which were easily obviated, the Duke accepted; and upon his accession to the throne, Arundel, who had returned with him to England, was restored to his see. In the first year of this prince's reign. Arundel summoned a synod which sat at St Paul's. The next year the commons moved that the revenues of the church might be applied to the service of the public; but Arundel opposed the motion with such vigour, that it was thrown aside. In the year 1408, Arundel began to exert himself against the Lollards, or Wickliffites; and his zeal for suppressing that sect carried him to several unjustifiable severities against the heads of it, particularly against Sir John Oldcastle and Lord Cobham. He also procured a synodical constitution, which forbad the translation of the Scriptures into the vulgar tongue. This prelate died at Canterbury, Feb. 20th, 1413, of an inflammation in his throat, with which he was seized (as it is pretended) whilst he was pronouncing sentence upon Lord Cobham. The Lollards asserted this to be a judgment from God; and indeed Bishop Goodwin speaks in the same manner, saying "He who had with-held from the people the word of God, the food of the soul, by the just judgement of God had his throat so closed, that he could not speak a single word, nor swallow meat or drink, and was so starved to death." He was buried in the cathedral church of Canterbury, near the west end, under a monument erected by himself in his lifetime. To this church he was a considerable benefactor: for he built the lantern-tower and great part of the nave; gave a ring of five bells, called from him *Arundel's ring*; several rich vestments, a mitre enchased with jewels, a silver gilt crosier, and two golden chalices.

Arundel, a borough and market town in Sussex, seated on the north-west side of the river Arun, over which there is a bridge. It had a harbour, wherein a ship of 100 ton burthen might ride; but the sea had ruined it so far, that, in 1733, an act passed for repairing it, and for erecting new piers, locks, &c. The castle, which gives the title of *earl* to its possessors, is seated on the east of the Tame, and is reputed to be a mile in compass. It sends two members to parliament; and is 55 miles south-west-by-south of London, and 10 miles east of Chichester. Arundel is the premier earldom in England, belonging to the illustrious family of Norfolk; and is the only title in England that goes along with the lands. W. Long. 0. 25. N. Lat. 50. 45.

Arundel Oil, in the materia medica. At Bombay, Gambroon, and Surat, in the East Indies, there grows a tree which bears a nut inclosed in a rough husk, which resembles much the horse-chesnut; and the kernel of the nut yields an oil by expression, which is of a purgative nature. A tea-spoonful of it is reckoned a dose. The tree goes by the name of the *Arundel tree* at Bombay, and its oil by that of the *Arundel oil*. Mr. Sinclair, one of the surgeons belonging to the royal regiment of artillery, who was formerly surgeon to an East India ship, gave Dr Monro of London a small bottle full of this oil, which he said was much used for the cure of the dysentery in India, and that he had given it in four recent cases of dysentery with success.—Dr Monro thinks it probable that this is the oil of the purging nuts mentioned in Dale's Pharmacologia, which are got from the tree called *Lignum Moluccense, Pavana dictum, fructu avellanæ,* J. B. 1. 342; and *pinus Indica, nucleo purgante,* C. B. 492; and the *palma Christi Indica,* Turnefort, Mat. Med.

Arundelian. ARUNDELIAN Marbles, Oxford Marbles, or Parian Chronicle, are ancient stones (as has been supposed), whereon is inscribed a chronicle of the city of Athens, engraven in capital letters in the island of Paros, one of the Cyclades, 264 years before Jesus Christ. They take their first name from Thomas Earl of Arundel, who procured them out of the East, or from Henry his grandson, who presented them to the University of Oxford.

The Arundelian Marbles, in their perfect state, contained a chronological detail of the principal events of Greece during a period of 1318 years, beginning with Cecrops, before Christ 1582 years, and ending with the archonship of Diognetus, before Christ 264. But the chronicle of the last 90 years is lost; so that the part now remaining ends at the archonship of Diotimus, 354 years before the birth of Christ: and in this fragment the inscription is at present so much corroded and effaced, that the sense can only be discovered by very learned and industrious antiquaries; or, more properly speaking, supplied by their conjectures.

This chronicle, and many other relics of antiquity, real or pretended, were purchased in Asia Minor, in Greece, or in the islands of the Archipelago, by Mr William Petty, who in the year 1624 was sent by Thomas Earl of Arundel for the purpose of making such collections for him in the East. They were brought into England about the beginning of the year 1627, and placed in the gardens belonging to Arundel-house in London.

Soon after their arrival they excited a general curiosity, and were viewed by many inquisitive and learned men; among others by Sir Robert Cotton, who prevailed upon Selden to employ his abilities in explaining the Greek inscriptions. Selden and two of his friends, Patrick Young, or, as he styled himself in Latin, *Patricus Junius*, and Richard James, immediately commenced their operations, by cleaning and examining the marble containing the Smyrnean and Magnesian league, and afterwards proceeded to the Parian Chronicle. The following year Selden published a small volume in quarto, including about 39 inscriptions copied from the marbles.

In the turbulent reign of Charles I. and the subsequent usurpation, Arundel-house was often deserted by the illustrious owners; and, in their absence, some of the marbles were defaced and broken, and others either stolen or used for the ordinary purposes of architecture. The chronological marble, in particular, was unfortunately broken and defaced. The upper part, containing 31 epochas, is said to have been worked up in repairing a chimney in Arundel-house.

In the year 1667, the Hon. Henry Howard, afterwards

Arundelian.

wards Duke of Norfolk, the grandson of the first collector, presented these supposed remains of antiquity to the university of Oxford.

Selden's work becoming very scarce, Bishop Fell engaged Mr. Prideaux to publish a new edition of the inscriptions, which was printed at Oxford in 1676. In 1732 Mr Maittaire obliged the public with a more comprehensive view of the marbles than either of his predecessors. Lastly, Dr Chandler published a new and improved copy of the marbles in 1763, in which he corrected the mistakes of the former editors; and in some of the inscriptions, particularly that of the Parian chronicle, supplied the *lacunæ* by many ingenious conjectures.

The Arundelian marbles have generally been regarded as a curious monument of antiquity. They were, however, discovered in some instances to be inconsistent with the most authentic historical accounts; Sir Isaac Newton and several other modern philosophers paid little or no regard to them; and of late their absolute authenticity has been severely questioned in an express dissertation upon the subject, entitled, *The Parian Chronicle*. In this dissertation much ingenuity as well as judgment and a great extent of ancient learning are displayed. His doubts, the author observes, arise from the following considerations.

I. "The characters have no certain or unequivocal marks of antiquity." The Π and Z, which frequently occur in the form supposed to be the most ancient (viz. the perpendicular line of the Π on the right hand only half as long as that on the left, and the Z in the form of a prostrate Ξ), are so well known, that any modern fabricator of a Greek inscription, which he intends to impose upon the world as a relic of antiquity, would most probably use them in preference to the more common and ordinary forms. But the letters in the Parian Chronicle have no appearance of antiquity except this very equivocal one. They do not in the least resemble the Sigean, the Nemean, or the Delian inscriptions, which are supposed to be of a more ancient date. They differ in many respects from the letters on the Marmor Sandvicense, which, according to the learned editor of that inscription, was engraved in the year before Christ 374. They bear no sort of resemblance to the characters on the Farnesian pillars, to those of the Alexandrian manuscript, or others of a later date. They seem, continues our author, to resemble perhaps more than any other the letters of the alphabet taken by Montfaucon from the Marmor Cyzicenum at Venice. They are plain and simple in their form, and such as an ordinary stone-cutter of the present age would probably make, if he were employed to engrave a Greek inscription according to the alphabet now in use. The small letters intermixed among the larger have, in the opinion of our author, an air of affectation and artifice, rather than genuine antiquity; and he is persuaded, that the antiquity of an inscription can never be proved by the mere form of the letters, because the most ancient characters may be as easily counterfeited as those which compose our present alphabets.

That the learned reader may form a competent idea of the characters in the Parian Chronicle, the author has compared them with those of other inscriptions, and given what is usually termed a *fac simile*.

In regard to several *archaisms*, as they are called, in this chronicle, and which our author specifies, he contends, that no conclusion can be drawn from them in favour of its antiquity. What reason could there be, he asks, for introducing these into the Parian chronicle? We do not usually find them in Greek writers of the same age, or even in those of the most early date. The reign of Ptolemy Philadelphus, with the 21st year of which the date of the chronicle coincides, was not an age of rude antiquity with respect to the Greek language; being only 130 years after the time of Xenophon and Plato, when the Greek was spoken and written in its utmost purity and elegance: and we can scarcely suppose, that even a stone-cutter, in that refined age, would have been permitted to disgrace a superb and learned monument with such barbarisms as occur in the chronicle. The archaisms, however, he remarks are not uniformly observed in this inscription. He adduces six instances of deviation; and adds, he is almost tempted to suspect that εμ Παρω εμ Μαραθωνι, and other pretended archaisms, are owing to a mere affectation of antiquity, or to a corrupted dialect and pronunciation in later ages. These archaisms, our author acknowledges, appear on other marbles; but he thinks, that, for that very reason, they would naturally be adopted by the fabricator of a supposititious inscription; and the authenticity of those inscriptions in which they appear must be established before they can be urged in opposition to the present argument.

II. "It is not probable that the chronicle was engraved for *private use*."—Our author thinks it an impossible supposition that such an expensive and cumbersome work could have been executed by a private citizen, either for his own amusement, or for the benefit of his fellow-citizens. In the first place, a long inscription could not be engraved in marble without such an expence as few learned Greeks were able to afford. Or, if its author, by an uncommon felicity, was able to erect such a literary monument, the scheme would have been useless and imprudent; as all the contents of the inscription might have been published more commodiously and effectually by the common mode of writing in use at that time.

A variety of arguments is adduced, illustrating the superiority of a manuscript to such an inscription as the chronicle, in a number of respects; and enforcing the improbability of its having ever been executed, either for public or private use. Much evidence from ancient history is likewise produced in support of the assertion, that the common mode of writing, in the reign of Ptolemy Philadelphus, was not on stones. It is not, however, necessary to prove, by the testimony of ancient authors, that books were written on parchment, or paper made of the Egyptian papyrus, or any such materials, before the date of the Parian chronicle. This is sufficiently evinced by the very existence of the writings of Moses, David, Solomon, and the Jewish prophets; the works of Homer, Hesiod, Anacreon, Pindar, Eschylus, Sophocles, Euripides, Herodotus, Hippocrates, Aristophanes, Thucydides, Xenophon, Plato, Demosthenes, Aristotle, &c. And it is still more incontestibly proved by the libraries which were collected in preceding ages, or about that time, such as those of Polycrates in Samos, Pisistratus and Euclides at Athens, Nicocrates in Cyprus, Euripides the poet,

Aristotle

Arundelian.

Ariſtotle the philoſopher, Clearchus at Heraclea Pontica, and the moſt extenſive and magnificent library of Ptolemy Philadelphus in Egypt, founded in or before the year 284, which in his time is ſaid to have contained 100,000 volumes, and to have been enlarged by his ſucceſſors to the amount of almoſt 700,000. Not long afterwards a library was founded at Pergamus by Attalus and Eumenes, which, according to Plutarch, contained 200,000. Theſe are clear and deciſive proofs, that the common mode of writing in the time of Ptolemy Philadelphus was not on ſtones.

III. "The chronicle does not appear to have been engraved by *public authority*."

1. The firſt argument in ſupport of this opinion is, that inſcriptions of that kind uſually begin with a particular form; as, Η ΒΟΤΛΗ ΚΑΙ Ο ΔΗΜΟΣ, 'The ſenate and the people;' or thus, ΕΔΟΞΕΝ ΤΗΙ ΒΟΤΛΗΙ ΚΑΙ ΤΟΙ ΔΗΜΩΙ, 'It pleaſed the ſenate and the people, &c.' But the Parian chronicle begins in the manner of a private man, ſpeaking of his own performance in the firſt perſon ſingular. This argument, our author remarks, cannot be much affected by obſerving, that the beginning of the inſcription is obliterated; for it is neceſſarily implied by the words now remaining.

2. The facts, and dates, which are mentioned in this chronicle, do not appear to have been extracted from any public records, or calculated to anſwer the purpoſe of authentic documents; as many eminent princes and magiſtrates are paſſed over without notice; in ſeveral inſtances, the tranſactions of whole centuries are omitted: and the facts, chiefly ſpecified are not matters of general or national importance.

3. The Parian inſcription is ſuch a one as we can hardly ſuppoſe the magiſtrates of the people of Paros would have ordered to be engraved. Stately ſepulchres, pillars, triumphal arches, and the like, were erected to perpetuate the glory of eminent men. The remembrance of events in which nations were intereſted, the ſucceſſion of princes, &c. were preſerved in the ſame manner. Leagues, decrees, and laws, were likewiſe engraved on marble or braſs, and fixed to a pillar, the walls of a temple, or other public buildings; becauſe ſuch inſcriptions were deſigned for the inſpection of the people, as they eſſentially concerned their conduct, their property, their liberty, or their lives. But, our author aſks, for whom could the chronicle of Paros be intended? It contains no encomiums on any of the patriots, the heroes, or the demigods of the country, no decrees of the magiſtrates, no public records, no laws of ſtate. On the contrary, it is a work of mere ſpeculation and learning, in which the inhabitants of that iſland, eſpecially the common people, had not the leaſt intereſt or concern.

Theſe words at the beginning, *αρχον τος εμ Παρω*, would naturally lead us to ſuppoſe, that the inſcription related to Paros. And, if ſo, it would have been natural for the author to have mentioned ſome of the moſt important occurrences in the hiſtory of that iſland. But, ſays this acute and learned critic, what ſcheme does our chronologer purſue on this occaſion? Does he record the events and revolutions of his own country? Does he mention any of the battles, ſieges, and treaties of the Parians? any of their public inſtitutions? any of their poets, patriots, or warriors? Does he mention Archilochus, who was honoured by his countrymen, and diſtinguiſhed as a poet in a general aſſembly of the Greeks?—Not a ſyllable on any of theſe ſubjects! On the contrary, he rambles from place to place, and records the tranſactions of Athens, Corinth, Macedon, Lydia, Crete, Cyprus, Sicily, Perſia, and other foreign countries with which Paros had no connection.

In this view the inſcription ſeems to have been as impertinent in the iſland of Paros, as a marble monument would be in this country, recording the antiquities of France or Spain, or one in Jamaica recording the revolutions of England. But upon ſuppoſition that the inſcription is a forgery, it is eaſy to account for this extraordinary circumſtance. A few chronological occurrences in the ancient hiſtory or Paros, would not have been ſo intereſting to the generality of readers, or ſo valuable in the eſtimation of every lover of antiquities, or, in ſhort, ſo profitable to the compiler, as a general ſyſtem of Grecian chronology.

IV. "The Greek and Roman writers, for a long time after the date of this work, complain that they had no chronological account of the affairs of ancient Greece." This poſition is confirmed by the teſtimony of Julius Africanus, Juſtin Martyr, Plutarch, Joſephus, Varro, Diodorus Siculus, and others; and the following ſeries of interrogatories is ſubjoined: 'Thucydides, I know, lived 140 years before the chronicle is ſaid to have been written; but if Thucydides, as well as other writers, complained that there was nothing but uncertainty in the earlier period of Grecian hiſtory, from whence can we ſuppoſe the author of this inſcription collected ſuch a clear, determinate, and comprehenſive ſyſtem of chronology? If we had any ſources of information, which were unknown to ſucceeding writers, how happens it, that they ſhould all of them overlook this moſt conſiderable, moſt exact, moſt creditable author? Why did they omit this ancient account of their early ages? Why did they not copy his moſt memorable epochas? Why did they not produce his authority? or, at leaſt, why did they not mention his opinion? Surely nothing, to all appearance, could be more elaborate, more important, or of higher authority, than a chronological table, which was thought worthy of being engraved on marble.

V. "The chronicle is not once mentioned by any writer of antiquity." This indeed appears a ſtrong argument againſt its authenticity. Apollodorus, an Athenian, the diſciple of Ariſtarchus the grammarian, and Panætius the philoſopher, wrote a genealogical and hiſtorical work on the early ages of Greece; but, though compoſed 120 years after the date of the Parian chronicle, it does not contain the ſmalleſt traces of a ſyſtematical chronology. It is remarkable too that the chronicle of Apollodorus is quoted by Diodorus Siculus, Strabo, Plutarch, A. Gellius, Lucian, and many other writers of antiquity; while the Parian chronicle, which comprehends a more extenſive period, is entirely unnoticed. It contains, however, ſuch wonderful diſcoveries in ancient hiſtory, that if it had exiſted 264 years before the Chriſtian æra, it muſt have excited a general attention, and been referred to as an authority by writers of ſucceeding times. But we do not find, in any author of antiquity, either poet or hiſtorian, geographer or chronologer, mythologiſt or ſcholiaſt, the moſt diſtant alluſion to the Parian chronicle; though it was ſuch a common practice among the

the ancients to mention the works of their predeceſſors, that in many books we find references and alluſions to three, four, five, ſix, or ſevent hundred different authors of every denomination.

VI. "Some of the facts mentioned in the chronicle ſeem to have been taken from writers of a later date." Our inquirer collates ſeveral paſſages in the Parian chronicle with parallel paſſages in Greek authors, to evince that there is, in the former, an appearance of imitation, or a ſtronger reſemblance than ſuch as may be ſuppoſed to ariſe from accident; that there are likewiſe ſome improbabilities attending the account of Deucalion, as related in the Parian chronicle; and that the names of ſix, and, if the lacunæ are properly ſupplied, the names of 12 cities appear to have been engraved on the marble, exactly as we find them in Ælian's Various Hiſtory. But there is not, our author obſerves, any imaginable reaſon for this particular arrangement. It does not correſpond with the time of their foundation, with their ſituation in Ionia, with their relative importance, or with the order in which they are placed by other eminent hiſtorians. The argument by which our author endeavours to prove that the Parian chronicle has, in this inſtance, copied Ælian's Various Hiſtory, ſeems deciſive of the fact. He obſerves, that ſix names may be tranſpoſed 720 different ways; and that 12 names admit of 479,001,600 different tranſpoſitions. Suppoſing then, there is no particular reaſon for one arrangement rather than another, it will follow, that the chance of two authors, placing them in the ſame order, is, in the former caſe, as 1 to 720; and in the latter, as 1 to 479,001,600. It is therefore, ſays he, utterly improbable, that theſe names would have been placed in this order on the marble, if the author of the inſcription had not tranſcribed them from the hiſtorian.

It may indeed be urged, with regard to this ſimilarity of arrangement in the Parian chronicle and Ælian's Various Hiſtory, that the inference might be the very inverſe of that which is ſpecified by our author. But that Ælian ſhould have ſeen the Parian chronicle, without once mentioning it; or that he ſhould have exactly copied a liſt of towns, arranged neither according to chronological nor topographical order; is indeed a ſuppoſition equally improbable with the other.

VII. "Parachroniſms appear in ſome of the epochas, which we can ſcarcely ſuppoſe a Greek chronologer in the 129th Olympiad would be liable to commit." After ſpecifying theſe, our inquirer aſks, Would a writer of reputation and learning, in one of the moſt poliſhed and enlightened æras of ancient Greece, commit ſuch miſtakes, in oppoſition to the poſitive atteſtations of the moſt accurate hiſtorians, in events of public notoriety? Would a private citizen, or a magiſtrate of Paros, order a crude and inaccurate ſeries of epochas to be engraved, at a great expence, and tranſmitted to poſterity on a marble moument? It is hardly probable.

VIII. "The hiſtory of the diſcovery of the Parian chronicle is obſcure and unſatisfactory. Our author obſerves, that it is attended with ſome ſuſpicious circumſtances, and without any of thoſe clear and unequivocal evidences which always diſcriminate truth from falſehood. There are no data in the inſcription by which to diſcover the place where the marble was erected. The place likewiſe where it was found is not aſcertained; though the generality of writers who have had occaſion to mention it have ſuppoſed that it was found in the iſland of Paros. If it was erected at Smyrna, as ſome imagine, our author aſks, for what purpoſe does the writer mention Aſtyanax the archon of Paros, and not one circumſtance relative to Smyrna? If, adds he, it was erected at Paros, why does he not mention more archons of that city than one? Or how ſhall we account for his profound ſilence with reſpect to all the events and revolutions which muſt have happened in that iſland, and have been infinitely more intereſting to the natives than the tranſactions of any foreign country?

The train of circumſtances by which the Parian chronicle came into the poſſeſſion of Mr Petty, whom Lord Arundel had ſent into the eaſt for the purpoſe of collecting antiquities, as well as the ſubſequent conduct of Peireſc, its former owner, affords our author a ſtrong preſumption, that, "the inſcription was actually fabricated, with the view of obtaining for it a high price, upon the pretence that it was a relic of great antiquity. It is certain, that there is ſomething myſterious in the conduct of the firſt oſtenſible proprietors. Theſe marbles had been totally unknown, or unnoticed, for almoſt 1900 years, and at laſt they are dug out of the ground—no body can tell us when or where!"

IX. "The literary world has been frequently impoſed upon by ſpurious books and inſcriptions; and therefore we ſhould be extremely cautious with regard to what we receive under the venerable name of antiquity." This propoſition is illuſtrated by a great variety of examples, and very properly expoſes the forgeries which have diſgraced the republic of letters in different ages; and although one of the more recent ones cited, namely, Oſſian's poems, be a point very far indeed from being eſtabliſhed, yet that deceptions of this kind have been practiſed is an unqueſtionable fact.

In endeavouring, towards the end of his diſſertation to inveſtigate the time of the ſuppoſed forgery, he obſerves, That the 16th century, and the prior part of the 17th, produced a multitude of grammarians, critics, and commentators, deeply verſed in Grecian literature, and amply qualified for the compilation of ſuch a chronological ſyſtem as that of the Arundelian marbles. Above all, the ſcience of chronology was particularly ſtudied and inveſtigated about that time: "Nunc fervet chronologia," ſays Scaliger in the year 1605, "omnes hoc ferrum excalfaciunt." Cauſabon treats thoſe perſons with contempt who were unacquainted with the improvements which had been made in that department of learning after the revival of letters. Innumerable ſyſtems of chronology had been publiſhed before the year 1625; from which it was eaſy to extract a ſeries of memorable events, and give the compilation a Grecian dreſs. "The avidity," ſays our author, "with which all relics of antiquity were then collected, and the high price at which they were purchaſed, were ſufficient inducements to any one, whoſe avarice or whoſe neceſſity was ſtronger than his integrity, to engrave his labours on marble, and tranſmit them to Smyrna, as a commodious emporium for ſuch rarities."

The preciſe period of the fabrication, however, muſt ſtill

Arundo.

still be reckoned apocryphal and uncertain. The sum of fifty guineas, which Peiresc gave to the supposed fabricator, was inadequate to such a laborious and expensive work. Upon the whole, perhaps, it would be too hasty to pronounce decisively that this famous Chronicle so long respected, is an imposition upon the public. It may, however, be safely affirmed, that the suspicions against it are extremely strong, and the objections already cited of a nature very difficult to be removed. No attempts have yet been made with this view: But under some future article, as CHRONOLOGY, MARBLES, or PARIAN *Chronicle*, we may possibly have an opportunity of resuming the subject with additional information.

ARUNDO, the REED: A genus of the digynia order, belonging to the triandria class of plants; and in the natural method ranking under the 4th order, *Gramina*. The calyx consists of two valves, and the flosculеs are thick and downy.

Species and properties. 1. The phragmitis, or common marsh-reed, grows by the sides of rivers and in standing waters. 2. The debax, or manured reed, is a native of warm countries, but will bear the cold of moderate winters in the open air. It dies to the surface in autumn, but appears again in the spring, and if kept supplied with water, will grow 10 or 12 feet high in one summer. The stalks of this are brought from Spain and Portugal; and are used by the weavers, as also for making fishing-rods. 3. The versicolor, or Indian variegated reed, is supposed to be a variety of the second, differing from it only in having variegated leaves. 4. The bambos, or bamboo *, is a native of the East Indies and some parts of America; where it frequently attains the height of 60 feet. The main root is long, thick, jointed, spreads horizontally, and sends out many cylindrical woody fibres, of a whitish colour, and many feet long. From the joints of the main root spring several round jointed stalks to a prodigious height, and at about 10 or 12 feet from the ground send out at their joints several stalks joined together at their base: these run up in the same manner as those they shoot out from. If any of these be planted with a piece of the first stalk adhering to them, they will perpetuate their species. They are armed at their joints with one or two sharp rigid spines, and furnished with oblong oval leaves, eight or nine inches long, seated on short footstalks. The flowers are produced in large panicles from the joints of the stalk, placed three in a parcel close to their receptacles: they resemble those of the common reed, and are succeeded by seeds of the same form surrounded with down.

* See *Bamboo*.

The young shoots are covered with a dark-green bark; these when very tender are put up in vinegar, salt, garlic, and the pods of capsicum, and thus afford a pickle, which is esteemed a valuable condiment in the Indies, and is said greatly to promote the appetite and assist digestion (see ACHIAR). The stalks in their young state are almost solid, and contain a milky juice: this is of a sweet nature; and as the stalks advance in age, they become hollow, except at the joints, where they are stopped by a woody membrane, upon which this liquor lodges, and concretes into a substance called *Tabaxir*, or sugar of *Mombu*, which was held in such esteem by the ancients, in some particular disorders, that it was equal in value to its weight in silver. The old stalks grow to five or six inches diameter, are then of a shining yellow colour, and so hard and durable that they are used in buildings, and for making all sorts of houshold furniture. These, when bored through the membranes at their joints, are converted into water-pipes. They serve also to make the sticks and poles with which the slaves or other persons carry those sorts of litters which are called *palanquins*, and are so common and convenient in all the East. The smaller stalks are used for walking-sticks. The inhabitants of Otaheite make flutes of them, about a foot long, with two holes only, which they stop with the first finger of the left hand and the middle one of the right, and they blow through their nostrils. 5. The arborea, with a tree-like stalk, differs from the former only in having narrower leaves. 6. The orientalis is what the Turks use as writing-pens; it grows in a valley near mount Athos, as also on the banks of the river Jordan. None of these plants are at present to be found in Britain.

Arundo, Arusini.

Culture. As all these plants grow naturally in low marshy lands, they must be supplied with plenty of water. The second kind requires little care; the third is more delicate, and requires to be kept in pots. The fourth, fifth, and sixth sorts must be preserved in stoves. They are to be planted in tubs filled with rich earth, and plentifully supplied with water. When the tubs decay, they may be suffered to grow into the tan, which will encourage them to grow to a larger size: but care must be taken, when the bed is refreshed with new tan, to leave a sufficient quantity of old tan about the roots of the plants; for if they are too much bared and the new tan laid near them, when that heats, it will scorch their roots, so that the plants are sometimes destroyed by it.

ARUNDO Saccharifera, or *Sugar-cane*. See SACCHARUM.

ARUSINI CAMPI (erroneously written *Taurasini* by Cluverius), plains in Lucania famous for the last battle fought between the Romans and Pyrrhus. That prince being at Tarentum, and hearing that the two new consuls Curius Dentatus and Cornelius Lentulus had divided their forces, the one including Lucania and the other Samnium; he likewise divided a chosen detachment of his army into two bodies, marching with his Epirots against Dentatus, in hopes of surprising him in his camp near Beneventum. But the consul, having notice of his approach, marched out of his entrenchments with a strong detachment of legionaries to meet him, repulsed his van-guard, put many of the Epirots to the sword, and took some of their elephants. Curius, encouraged by this success, marched into the Arusian fields, and drew up his army in a plain, which was wide enough for his troops, but too narrow for the Epirot phalanx to act with its full effect. But the king's eagearness to try his strength and skill with so renowned a commander, stimulated him to engage at that great disadvantage. Upon the first signal the action began; and one of the kings wings giving way, victory seemed to incline to the Romans. But that wing where the king fought in person repulsed the enemy, and drove them to their intrenchments. This advantage was in great part owing to the elephants; a circumstance which Curius perceiving, commanded a body of reserve, which he had posted near the

the camp, to advance and attack those animals with burning torches; which frightened and annoyed them to such a degree, that they wheeled about, broke into the phalanx, and put that body into the utmost disorder. The Romans taking advantage of this confusion, charged with such fury that the enemy were entirely broken and defeated. Pyrrhus retired to Tarentum, attended only by a small body of horse, leaving the Romans in full possession of his camp; which they so much admired, that they made it a model which they followed ever after.

ARUSPICES, or HARUSPICES, in Roman antiquity, an order of priests who pretended to fortel future events by inspecting the intrails of victims killed in sacrifice; they were also consulted on occasion of portents and prodigies. The haruspices were always chosen from the best families; and as their employment was of the same nature as that of the augurs, they were as much honoured. Their college, as well as those of the other religious orders, had its particular registers and records.

ARX, in the ancient military art, a town, fort, or castle, for defence of a place.

The arx in ancient Rome was a distinct edifice from the capitol, though some have confounded the two. According to Ryckius, the arx, properly speaking, was a place on the highest part of the Capitoline Mount, stronger and better fortified than the rest, with towers and pinnated walls: in which was also the temple of Jupiter Capitolinus.

ARX also denoted a consecrated place on the Palatine Mount, where the augurs publicly performed their office. Some will have the arx to have been the augural temple; but Varro expresly distinguishes between the two.

ARX was particularly used for a public place in Rome, set apart for the operations of the augurs. In which sense arx amounts to the same with what is otherwise called *auguraculum* and *auguratorium*, and in the camp *augurale*. Out of this arx it was that the *feciales*, or heralds, gathered the grass used in the ceremony of making leagues and treaties.

ARX Britannica, a citadel of Batavia, whose foundation is seen at low water, near the old mouth of the middle Rhine: some imagine it the pharos or high tower of Caligula, as Suetonius calls it; a monument of Caligula's sham conquest of Britain. Others, that it was built by Drusus, with an altar afterwards by Claudius, on his expedition into Britain. But the usual passage was from Gessoriacum; and Suetonius expresly says, Claudius passed over thence. The ancient name of this citadel, now covered by the sea, is no where expressed: Now commonly called *'t Huis Britten*, or *Brittenburg*; that is, *Arx Britannica*; but from what authority does not appear.

ARYTENOIDES, in anatomy, the name of two cartilages which, together with others, constitute the head of the larynx. It is also applied to to some muscles of the larynx.

ARYTHMUS, in medicine, the want of a just modulation in the pulse. It is opposed to *eurythmus*, a pulse modulated agreeably to nature.

ARZILLA, a very ancient maritime town of Africa, in the kingdom of Fez, about five leagues from Tangiers. It is built at the mouth of a river, and inhabited by Moors and Jews, who carry on no trade. It was formerly a Roman colony; afterwards fell under the government of the Goths, and was next taken by the Mahometans. Alphonso of Portugal, surnamed the African, took it by assault in 1471, and brought away the presumptive heir of the crown. After that prince came to the throne, he besieged it, in 1508, with 100,000 men; but was obliged to abandon the undertaking. However, at length the Portuguese forsook it of their own accord. W. Long. 5. 30. N. Lat. 35. 30.

AS, in antiquity, a particular weight, consisting of 12 ounces; being the same with *libra*, or the Roman pound. The word is derived from the Greek *αις*, which in the Doric dialect is used for *εις*, *one*, q. d. an entire thing; though others will have it named *as* quasi *æs*, because made of brass.

As was also the name of a Roman coin, which was of different weights and different matter in different ages of the commonwealth.—Under Numa Pompilius, according to Eusebius, the Roman money was either of wood, leather, or shells. In the time of Tullus Hostilius it was of brass: and called *as*, *libra*, *libella*, or *pondo*, because actually weighing a pound or 12 ounces. Four hundred and twenty years after, the first Punic war having exhausted the treasury, they reduced the *as* to two ounces. In the second Punic war, Hannibal pressing very hard upon them, they reduced the *as* to half its weight, viz. to one ounce. And lastly, by the Papirian law, they took away half an ounce more, and consequently reduced the *as* to the diminutive weight of half an ounce: and it is generally thought that it continued the same during the commonwealth, and even till the reign of Vespasian. The *as* therefore was of four different weights in the commonwealth. Its original stamp was that of a sheep, ox, or sow: but from the time of the emperors, it had on one side a Janus with two faces, and on the reverse the rostrum or prow of a ship.

As was also used to denote any integer or whole. Whence the English word *ace*.—Thus *as* signified the whole inheritance; whence *hæres ex asse*, the heir to the whole estate.

ASA, king of Judah, succeeded his father Abijam. He pulled down the altars erected to idols, restored the worship of the true God, and, with the assistance of Benhadad king of Syria, took several tows from the king of Israel. He died 917 years before the Christian æra, and was succeeded by Jehoshaphat.

ASA, among naturalists. The writers of the later ages have formed this word *asa* from the lasar of the ancients, and attributed it to a gum very different from that anciently known by the name they have thus corrupted.

The asa of the ancients was an odoriferous and fragrant gum; and the asa of the after-ages had so little title to this epithet, that they distinguished it by one, expressing its being of an offensive or stinking smell. The Arabian writers, according to this distinction, describe two kinds of asa, the one stinking, the other aromatic; and the modern Greeks preserved the name *asa*, or *lasa*, to the stinking gum the Latins called by that name, but added a distinctive epithet to express its smell, and called it *scardolasarum*.

Asa or Assa, in the materia medica, a name given to two very different substances, called *asa-dulcis* and *asa-fœtida*.

Asa-Dulcis is the same with Benzoin.

Asa-Fœtida is the concrete juice of a large umbelliferous plant growing in several parts of Asia; the properties of which are described under the article Ferula.

ASAPH (St), a city in Flintshire, with a bishop's see; on which account principally it deserves notice, being in itself but a poor place. As a bishoprick, it is of great antiquity, and was founded about the year 560, by Kentigern, a Scotsman, bishop of Glasgow. He began the church on the banks of the river Elwy, whence it is called by the Welsh *Land Elwy*, and in Latin *Elwensis*. Kentigern returning into Scotland, left a holy man his successor, St Asaph. Who was his successor is uncertain, as there are no records that mention it; and it seems rather probable that the religious settled here had been necessitated to remove to some more peaceful abode, as the country was frequently the seat of war between the English and the Welsh. This see was formerly a very wealthy one; but its revenues were greatly lessened by the profusion of bishop Parfew, who alienated much of the lands belonging to this bishoprick.

This diocese doth not contain any one whole county; but consists of part of Denbigh, Flint (where its church is), Montgomery, and Merioneth shires, and a small part of Shropshire; wherein are 121 parishes, and 131 churches and chapels, most of which are in the immediate patronage of the bishop. This see hath but one archdeaconry, viz. that of St Asaph, which is united to the bishoprick, for the better maintenance thereof. This see is valued in the king's books at L. 187 : 11, 6, but computed to the worth annually L. 1500. The tenth of the clergy comes to L. 186 : 19 : 6¾. To this cathedral belongs a bishop, a dean, archdeacon, chancellor, &c.

ASAPPES, or Azapes, an order of soldiers in the Turkish army, whom they always expose to the first shock of the enemy; to the end that the enemy being thus fatigued, and their swords blunted, the spahis and janisaries may fall on and find an easy conquest. The word is derived from the Turkish *saph*, which signifies *rank*, from whence they have formed *asphaph*, "to range in battle." The asappes are said to be held of so little value, that they frequently serve as bridges for the cavalry to pass over in bad roads, and as fascines to fill up the ditches of places besieged. They travel on foot, and have no pay but the plunder they can get from the enemy.

ASAR-addon, or Esar-Haddon, the son of Sennacherib, succeeded his father about 712 years before the Christian æra, and united the kingdoms of Nineveh and Babylon. He rendered himself master of Syria; sent a colony to Samaria; and his generals took king Manesses, and carried him loaded with chains to Babylon. Asar-Addon died after a reign of 12 years.

ASARINA. See Chelone.

ASAROTA, ασαρωτα, from α and σαιρω, *I sweep*, a kind of painted pavements in use before the invention of mosaic work. The most celebrated was that at Pergamus, painted by Sesus, and exhibiting the appearance of crumbs, as if the floor had not been swept after dinner, whence, according to Pliny, the denomination. Perrault supposes them to have been a black kind of pavements of a spongy matter.

ASARUM, asarabacca: A genus of the monogynia order, belonging to the dodecandria class of plants. The calyx is trifid or quadrifid, and rests on the germen; there is no corolla; the capsule is leathery and crowned.—The species are three; the Europeum, the Canadense, and Virginicum. The first species grows naturally in some parts of England. It hath thick fleshy jointed roots; the leaves grow singly upon short foot-stalks, which arise immediately from the root: the flowers grow upon very short foot-stalks close to the ground, so are hid under the leaves. They have a bell-shaped impalement, of a worn-out purple colour, which is cut in three at the top, where it turns backward. It delights in a moist shady place, and may be propagated by parting the roots in autumn. The two other species have no remarkable properties.

Medicinal Uses. The dried roots of this plant have been generally brought from the Levant; those of our own growth being supposed weaker. Both the roots and leaves have a nauseous, bitter, acrimonious, hot taste; their smell is strong, and not very disagreeable. Given in substance from half a dram to a dram, they evacuate powerfully both upwards and downwards. It is said, that tinctures made in spirituous menstrua, possess both the emetic and cathartic virtues of the plant; that the extract obtained by inspissating these tinctures, acts only by vomit, and with great mildness; that an infusion in water proves cathartic, rarely emetic; that aqueous decoctions made by long boiling, and the watery extract, have no purgative or emetic quality, but prove notable diaphoretics, diuretics, and emmenagogues.

The principal use of this plant among us is as a sternutatory. The root of asarum is perhaps the strongest of all the vegetable errhines, white hellebore itself not excepted. Snuffed up the nose, in the quantity of a grain or two, it occasions a large evacuation of mucus, and raises a plentiful spitting. The leaves are considerably milder, and may be used to the quantity of three, four, or five grains. Geoffroy relates, that after snuffing up a dose of this errhine at night, he has frequently observed the discharge from the nose to continue for three days together; and that he has known a paralysis of the mouth and tongue cured by one dose. He recommends this medicine in stubborn disorders of the head proceeding from viscid tenacious matter, in palsies, and in soporific distempers. The leaves are the principal ingredient in the *pulvis sternutatorius* or *pulvis asari compositus*, as it is now called, of the shops.

ASBAMEA, a fountain of Cappadocia, near Tyana, sacred to Jupiter, and to an oath. Though this fountain bubbled up, as in a state of boiling, yet its water was cold; and never ran over, but fell back again: (Philostratus, Ammian).

ASBESTOS, a sort of native fossile stone, which may be split into threads and filaments, from one inch to ten inches in length, very fine, brittle, yet somewhat tractable, silky, and of a greyish colour, not unlike talc of Venice. It is almost insipid to the taste, indissoluble in water, and endued with the wonderful property of remaining unconsumed in the fire, which only whitens it. There are some sorts of asbestos whose

whose filaments are rigid and brittle; others more flexible.

The industry of mankind has found a method of working this untoward mineral, and employing it in divers manufactures, chiefly cloth and paper. The manufacture is undoubtedly difficult enough. Pliny calls the asbestos *inventu rarum, textu difficilimum*. Wormius assures us, that the method of making cloth of asbestos is now entirely unknown. And indeed one would scarce imagine the thing practicable, without the mixture of some other pliant matter, as wool, hemp, or flax, along with the asbestos, the filaments of this latter appearing too coarse and brittle to make any tolerable fine work. However this be, Bapt. Porta assures us, that in his time the spinning of asbestos was a thing known to every body at Venice. Sig. Castagnatta, superintendant of some mines in Italy, is said to have carried the manufacture to such perfection, that his asbestos was soft and tractable, much resembling lamb-skin dressed white: he could thicken and thin it at pleasure, and thus either make it into a very white skin or a very white paper.

This kind of linen cloth was chiefly esteemed by the ancients; though then better known and more common than among us, being held equally precious with the richest pearls: nor is it now of mean value, even in the country where it is most generally made, a China cover (i. e. a piece of 23 inches and three-quarters long) being worth 80 tale, i. e. L. 36 : 13 : 4. Pliny says, he himself had seen napkins thereof, which, being taken foul from the table after a feast, were thrown into the fire, and by that means were better scoured than if they had been washed in water, &c. But its principal use, according to Pliny, was for the making of shrouds for royal funerals, to wrap up the corpse, so that the ashes might be preserved distinct from those of the wood, &c. whereof the funeral pile was composed: and the princes of Tartary, according to the accounts in the Philosophical Transactions, still use it at this day in burning their dead. Some of the ancients are said to have made themselves clothes of it, particularly the Brachmans among the Indians. The wicks for their perpetual lamps, according to Dr Lister, were also made of it: some to this day use it for the wicks of such lamps as they would not have any trouble with; because the asbestos never wasting, there is no occasion for shifting the wick. Septalla, canon of Milan, had thread, rope, nets, and paper, made of the asbestos. A handkerchief or pattern of this linen was long since presented to the Royal Society, a foot long and half a foot broad. This gave two proofs of its resisting fire; though, in both experiments, it lost above three drams in its weight. When taken out red-hot, it did not burn a piece of white paper on which it was laid. Mr. Villette pretends that his large burning concave usually vitrifies the asbestos.

The method of preparing the incombustible paper and cloth is thus described by Ciampini: The stone is laid to soak in warm water; then opened and divided by the hands, that the earthy matter may be washed out. The ablution being several times repeated, the flax-like filaments are collected and dried; and they are most conveniently spun with an addition of flax. Two or three filaments of the asbestos are easily twisted along with the flaxen thread, if the operator's fingers are kept oiled. The cloth also, when woven, is best preserved by oil from breaking or wasting. On exposure to the fire, the flax and the oil burn out, and the cloth remains pure and white. Probably from the dissipation of some extraneous matter of this kind proceeded the diminution of weight in the handkerchief just recited; for pure asbestos leaves nothing. The shorter filaments which separate in washing the stone may be made into paper in the common manner.

The asbestos is found in Crete and Cyprus; in Tartary; at Namur in the Low Countries; in Thuringia among the mines; in the Old Noricum; in Egypt; in the mountains of Arcadia; at Puteoli; in the island of Corsica; in the island of Anglesey in Wales; in Aberdeenshire in Scotland: at Montauban in France; and in the kingdom of Siberia.

ASCALON, an ancient city, and one of the five satrapies or principalities of the Philistines; situated on the Mediterranean, 43 miles to the south-west of Jerusalem (Antonine), between Azotus to the north and Gaza to the south. The birth-place of Herod the Great, thence surnamed *Ascalonita* (Stephanus). Famous for its scallions, which take name from this town (Strabo, Pliny). Now *Scalona*. E. Long. 34. 30. Lat. 31. 30.

ASCANIUS, the son of Æneas and Creusa, succeeded his father in the kingdom of the Latins, and defeated Mezentius king of the Tuscans, who had refused to conclude a peace with him. At length he founded Alba Longa; and died about 1139 years before the Christian æra, after a reign of 38 years.

ASCARIS, in zoology, a genus of insects belonging to the order of vermes intestina. The body of the ascaris is cylindrical, filiform, and tapers at both ends. The species are two, viz. 1. The vermicularis, with faint annular rugæ, and the mouth transverse, is about a quarter of an inch long, and thicker at one end than the other. It is found in boggy places, in the roots of putrid plants, and very frequently in the rectum of children and horses. It emaciates children greatly, and is sometimes vomited up. 2. The lumbricoides is about the same length with the lumbricus terrestris, or common earth-worm; but it wants the protuberant ring towards the middle of the body, the only mark by which they can properly be distinguished. The body of the lumbricoides is cylindrical, and subulated at each extremity; but the tail is somewhat triangular. The lumbricoides is the worm which is most commonly found in the human intestines. It is viviparous, and produces vast numbers. For the method of expelling these two kinds of insects, see MEDICINE-*Index*.

Plate LV.

ASCENDANT, in astrology, denotes the horoscope, or the degree of the ecliptic which rises upon the horizon at the time of the birth of any one. This is supposed to have an influence on the person's life and fortune, by giving him a bent and propensity to one thing more than another.

In the celestial theme, this is also called the *first house*, the *angle of the East* or *Oriental angle*, and the *significator of life*.—Such a planet ruled in his *ascendant*: Jupiter was in his *ascendant*, &c.—Hence the word is also used in a moral sense, for a certain superiority which one man has over another, from some unknown cause.

ASCENDANTS, in law, are opposed to descendants in

Ascending, Ascension. in ſucceſſion; i. e. when a father ſucceeded his ſon, or an uncle his nephew, &c. heritage is ſaid to aſcend, or go to aſcendants.

ASCENDING, in aſtronomy, is ſaid of ſuch ſtars as are riſing above the horizon in any parallel of the equator.

Ascending Latitude, is the latitude of a planet when going towards the north pole.

Ascending Node, is that point of a planet's orbit wherein it paſſes the ecliptic, to proceed northward. This is otherwiſe called the *northern node*, and repreſented by this character ☊.

Ascending Veſſels, in anatomy, thoſe which carry the blood upwards; as the aörta aſcendens. See Anatomy, n° 123.

ASCENSION, in aſtronomy, is either right or oblique. Right aſcenſion of the ſun, or a ſtar, is that degree of the equinoctial, counted from the beginning of aries, which riſes with the ſun or ſtar in a right ſphere. Oblique aſcenſion is an arch of the equator intercepted betwen the firſt point of aries and that point of the equator which riſes together with a ſtar in an oblique ſphere.

Ascension Day, a feſtival of the Chriſtian church, held ten days before Whitſuntide, in memory of our Saviour's aſcenſion into heaven after his reſurrection.

Ascension Iſland, a barren iſland on the coaſt of Africa, lying in W. Long. 17. 20. S. Lat. 7. 5. The following account is given of it by Mr Forſter. "This iſland was firſt diſcovered in 1501, by Joaõ de Nova Galego, a Portugueſe navigator, who named it *Ilha de Noſſa Senhora de Conceiçao*. The ſame admiral, on his return to Portugal in 1502, diſcovered the iſland of St Helena, which obtained that name from the day of the diſcovery. Aſcenſion was ſeen a ſecond time by Alfonſo d'Albuquerque on his voyage to India in 1503, and then received the name it now bears; but was already at that time in the ſame deſolate condition as at preſent. "We ſent ſeveral parties on ſhore, who paſſed the night on the watch for turtles, which came to lay their eggs on the ſandy ſhores. The drearineſs of this iſland ſurpaſſed all the horrors of Eaſter Iſland and Tierra del Fuego, even without the aſſiſtance of ſnow. It was a ruinous heap of rocks, many of which, as far as we could diſcern from the ſhip, ſeemed to be totally changed by the fire of a volcano. Nearly in the centre of the iſland riſes a broad white mountain of great height, on which we diſcerned ſome verdure by the help of our glaſſes, from whence it has obtained the name of *Green Mountain*.

"We landed early in the morning among ſome rocks, the ſurf being always immenſely high on the great beach; which conſiſts of minute ſhell-ſand, chiefly of a ſnowy white, very deep, dry, and intolerable to the eyes when the ſun ſhines. We aſcended among heaps of black cavernous ſtone, which perfectly reſembles the moſt common lavas of Veſuvius and Iceland, and of which the broken pieces looked as if they had been accumulated by art. The lava currents cooling very ſuddenly, may eaſily be imagined to produce ſuch an effect. Having aſcended about 12 or 15 yards perpendicular, we found ourſelves on a great level plain of ſix or eight miles in circuit; in the different corners of which we obſerved a large hill of an exact conical ſhape, and of reddiſh colour, ſtanding perfectly inſulated. Part of the plain between theſe conic hills was covered with great numbers of ſmaller hillocks, conſiſting of the ſame wild and ragged lava as that near the ſea, and ringing like glaſs when two pieces are knocked together. The ground between the heaps of lava was covered with a black earth, on which we walked very firmly; but when theſe heaps did not appear, the whole was a red earth, which was ſo looſe, and in ſuch dry minute particles, that the wind raiſed clouds of duſt upon it. The conic hills conſiſted of a very different ſort of lava, which was red, ſoft, and crumbling into earth. One of theſe hills ſtands directly in front of the bay, and has a wooden croſs on its ſummit, from whence the bay is ſaid to take its name. Its ſides are very ſteep, but a path near three quarters of a mile long winds round it to the ſummit. After examining this remarkable country a little longer, we concluded, with a great degree of probability on our ſide, That the plain on which we ſtood was once the crater or ſeat of a volcano, by the accumulation of whoſe cinders and pumice-ſtones the conic hills had been gradually formed: that the currents of lava which we now ſaw divided into many heaps, had perhaps been gradually buried in freſh cinders and aſhes; and the waters coming down from the interior mountain in the rainy ſeaſon had ſmoothened every thing in their way, and filled up by degrees the cavity of the crater. The rocky black lava was the reſidence of numberleſs men-of-war birds and boobies, which ſat on their eggs, and ſuffered us to come cloſe to them.

"About eight in the evening, it being then quite dark, a ſmall veſſel came into the bay, and anchored directly within us. Captain Cook having hailed her repeatedly, received in anſwer that ſhe was the Lucretia, a New-York ſloop, which had been at Sierra Leon, and was now come to catch turtles, in order to ſell them at the windward iſlands of the Weſt Indies. A lieutenant was ſent on board, who learned from the maſter, that he had taken our ſhip to be a French Indiaman, and was very deſirous of trading with Engliſh India-ſhips, in which he was diſappointed by the company's regulations. He dined with our officers the next day, but on the 31ſt at day-break left the iſland. On the 30th in the morning, we landed a ſecond time; and croſſing the plain, arrived at a prodigious lava-current, interſected by many channels from ſix to eight yards deep, which bore ſtrong marks of being worn by vaſt torrents of water, but were at preſent perfectly dry, the ſun being in the northern hemiſphere. In theſe gullies we found a ſmall quantity of ſoil conſiſting of a black volcanic earth, mixed with ſome whitiſh particles gritty to the touch. Here we ſaw ſome ſmall bunches of purſlane, and a ſpecies of graſs (*panicum ſanguineum*) which found ſufficient nutriment in the dry ſoil. Having at laſt, with great fatigue, climbed over this extenſive and tremendous current of lava, which was much more ſolid than the heaps nearer to the ſea, we came to the foot of the Green Mountain, which even from the ſhip's place in the bay we had plainly diſtinguiſhed to be a different nature from all the reſt of the country. Thoſe parts of the lava which ſurrounded it were covered with a prodigious quantity of purſlane, and a kind of new fern (*lonchites Adſcenſionis*), where ſeveral flocks of wild goats were feeding. The great mountain is divided in its extremities, by by various clefts, into ſeveral bodies; but in the centre they all run together, and form one broad maſs of great height. The whole appears to conſiſt of a gritty tophaceous lime-ſtone, which has never been attacked by the volcano, but probably exiſted prior to its eruption; its ſides are covered with a kind of graſs, peculiar to the iſland, which Linnæus has named *ariſtida Adſcenſionis*. We likewiſe obſerved ſeveral flocks of goats feeding on it; but they were all exceſſively ſhy, and ran with ſurpriſing velocity along tremendous precipices, where it was impoſſible to follow them. The maſter of the New-York ſloop acquainted us, that there is a ſpring of water on one part of this mountain, which falls down a great precipice, and is afterwards abſorbed in the ſand. I am almoſt perſuaded, that with a little trouble, Aſcenſion might ſhortly be made fit for the reſidence of men. The introduction of furze (*ulex Europæus*), and of a few other plants which thrive beſt in a parched ſoil, and are not likely to be attacked by rats or goats, would ſoon have the ſame affect as at St Helena. The moiſture attracted from the atmoſphere by the high mountains in the centre of the iſland, would then no longer be evaporated by the violent action of the ſun, but collect into rivulets, and gradually ſupply the whole iſland. A ſod of graſſes would every where cover the ſurface of the ground, and annually increaſe the ſtratum of mould, till it could be planted with more uſeful vegetables.

"We returned gradually to Croſs Bay, in the heat of noon, over the plain; having a ſpace of more than five miles to traverſe, where the ſun burnt and bliſtered our faces and necks, and heated the ſoil to ſuch a degree, that our feet were likewiſe extremely ſore. About three o'clock we arrived at the water's ſide; and after bathing in a ſmall cove among a few rocks, we made the ſignal for a boat, and were taken on board. The next forenoon we made another ſmall excurſion, in company with Captain Cook, towards the Green Mountain; but we were all of us ſo much fatigued, that we could not reach it. We made no new obſervations in the courſe of this day, the nature of the iſland being dreary beyond deſcription in its outſkirts."

ASCENSIONAL DIFFERENCE, the difference between the right and oblique aſcenſion of the ſame point to the ſurface of the ſphere.

ASCENT, in a general ſenſe, implies the motion of a body upwards, or the continual receſs of a body from the earth. The Peripatetics attribute the ſpontaneous *aſcent* of bodies to a principle of levity inherent in them. The moderns deny any ſuch thing as ſpontaneous levity; and ſhew, that whatever *aſcends*, does it in virtue of ſome external impulſe or extruſion. Thus it is that ſmoke and other rare bodies *aſcend* in the atmoſphere; and oil, light woods, &c. in water; not by any external principle of levity, but by the ſuperior gravity or tendency downwards of the parts of the medium wherein they are. The *aſcent* of light bodies in heavy mediums is produced after the ſame manner as the *aſcent* of the lighter ſcale of a balance. It is not that ſuch ſcale has an internal principle whereby it immediately tends upwards; but it is impelled upwards by the preponderancy of the other ſcale; the exceſs of the weight of the one having the ſame effect, by augmenting its impetus downwards, as ſo much real levity in the other; by reaſon the tendencies mutually oppoſe each other, and that action and reaction are always equal.

Ascent of Bodies on Inclined Planes, the reader will find explained under MECHANICS; *Aſcent of Fluids*, under HYDROSTATICS; and *Aſcent of Vapours*, under the article EVAPORATION.

ASCESIS, properly denotes exerciſe of the body. It is formed from the verb ασκειν, uſed by the ancients in ſpeaking of the ſports and combats of the athletæ.

ASCESIS is alſo uſed by philoſophers, to denote an exerciſe, conducive to virtue, or to the acquiring a greater degree of virtue. This is particularly denominated the *philoſophical aſceſis*, becauſe practiſed chiefly by philoſophers, who make a more peculiar profeſſion of improving themſelves in virtue; on the model whereof, the ancient Chriſtians introduced a religious Aſceſis.

ASCETERIUM, in eccleſiaſtical writers, is frequently uſed for a monaſtery, or place ſet apart for the exerciſes of virtue and religion. The word is formed from *aſceſis*, "exerciſe;" or *aſcetra*, "one who performs exerciſe." Originally is ſignified a place where the athletæ or gladiators performed their exerciſes.

ASCETIC, an ancient appellation given to ſuch perſons as, in the primitive times, devoted themſelves more immediately to the exerciſes of piety and virtue, in a retired life; and particularly to prayer, abſtinence, and mortification. The word is derived from ασκεω, *exercio*, "I exerciſe." Afterwards, when the monks came in faſhion, this title was beſtowed upon them; eſpecially upon ſuch of them as lived in ſolitude.

ASCETIC is alſo a title of ſeveral books of ſpiritual exerciſes.—As, the *Aſciatics*, or devout exerciſes of St Baſil, archbiſhop of Cæſarea in Cappadocia.

We alſo ſay the *aſcetic* life, meaning the exerciſe of prayer, meditation, and mortification.

ASCHAFENBURG, a town of Germany, ſeated on the river Maine, in the circle of the Lower Rhine, and territory of the elector of Mentz, who has a palace there. It is memorable for being the place where the king of Great Britain took up his quarters the night before the battle of Dettingen. E. Long. 9. 35. N. Lat. 50. 14.

ASCHAM (Roger), was born at Kirby-Wiſke, near North-Allerton in Yorkſhire, in the year 1516. His father was ſteward to the noble family of Scroop. Our author Roger was educated in the family of Sir Anthony Wingfield, who, about the year 1530, ſent him to St John's College, Cambridge, where he was ſoon diſtinguiſhed for his application and abilities. He took his degree of Bachelor of Arts at the age of 18, was ſoon after elected fellow of his college, and in 1536 proceeded Maſter of Arts. In 1544, he was choſen univerſity orator; and, in 1548, was ſent for to court, to inſtruct the lady Elizabeth (afterwards queen) in the learned languages. In the year 1550, he attended Sir Richard Moryſine, as ſecretary, on his embaſſy to the emperor Charles V. at whoſe court he continued three years, and in the mean time was appointed Latin ſecretary to King Edward VI. But, upon the death of that prince, he loſt his preferment and all his hopes, being profeffedly of the reformed religion; yet, contrary to his expectations, he was foon after, by the intereft of his friend lord Paget, made Latin fecretary to the king and queen. In June 1554, he married Mrs Margaret How, a lady of a good family, with whom he had a confiderable fortune. It is very remarkable of Mr Afcham, that, tho' he was known to be a Proteftant, he continued in favour not only with the miniftry of thofe times, but with queen Mary herfelf. Upon the acceffion of queen Elizabeth, he was not only confirmed in his poft of Latin fecretary, but was conftantly employed as preceptor to her Majefty in the Greek and Latin languages. He died in the year 1568, much regretted, efpecially by the queen, who faid fhe had rather have loft L. 10,000. Camden and fome other writers tell us, that he had a great propenfity to dice and cock-fighting. He certainly died poor.—He wrote,

1. Toxophilus. The fchole or partitions of fhooting, contayned in two bookes, written by Roger Afcham, 1544, and now newly perufed. Pleafaunt for all gentlemen and yeomen of England, &c. Lond. 1571. Whilft at the univerfity he was fond of archery by way of exercife and amufement, for which he was cenfured; and on that account he fat down to write this book, which was dedicated to Henry VIII. who fettled a penfion of L. 10 per annum, on the author. It is rather whimfical; but is admirably well written, and full of learning. 2. A report and difcourfe, written by Roger Afcham, of the affairs and ftate of Germany, and the emperor Charles his court, &c. 4to. A valuable curiofity. 3. The fchoolmafter. Firft printed in 1573, 4to. Mr Upton publifhed an edition with notes in 1711. It has uncommon merit; abounding in great good fenfe, as well as knowledge of ancient and modern hiftory: it is alfo expreffive of the great humanity of the author, who was for making the paths of knowledge as level and pleafant as poffible, and for trying every gentle method of enlarging the mind and winning the heart. 4. Latin epiftles. Firft publifhed by Mr Grant in 1576; have fince paffed many editions: the beft is that of Oxford in 1703. Much admired on account of the ftyle, and efteemed almoft the only claffical work of that kind written by an Englifhman. 5. Apologia contra miffam. 1577, 8vo.

ASCIBURGIUM (anc. geog.), mentioned by Tacitus, fuppofed to be one of the 50 citadels built on the Rhine; who adds, fome imagined it was built by Ulyffes. Here was a Roman camp and a garrifon. To its fituation on the banks of the Rhine anfwers a fmall hamlet, now called *Afburg*, not far from Meurs, in the duchy of Cleves.

ASCIDIA, a genus of animals belonging to the order of vermes Mollufca. The body is cylindrical, and fixed to a fhell, rock, &c. It has two appertures; one on the fummit, the other lower, forming a fheath. There are fix fpecies of this animal, viz. the papillofum, gelatinofum, inteftinalis, quadridentata, ruftica, and echinata; only one of which, viz. the ruftica*, is found in the Britifh feas. Animals of this genus have the faculty of fquirting out the water they take in. The expanfion and contraction of their bodies occafion their affuming various forms.

*Pl. LVI.

ASCII, among geographers, an appellation given to thofe inhabitants of the earth who, at certain feafons of the year, have no fhadow; fuch are all the inhabitants of the torrid zone, when the fun is vertical to them.

ASCITÆ (from ασκος, a *bag* or *bottle*), in antiquity, a fect or branch of Montanifts, who appeared in the fecond century, they were fo called, becaufe they introduced a kind of Bacchanals into their affemblies, who danced round a bag or fkin blowed up; faying, they were thofe new bottles filled with new wine whereof our Saviour makes mention, Matth. ix. 17.—They are fometimes alfo called *Afcodrogitæ*.

ASCITES, in medicine, the dropfy of the abdomen. See MEDICINE-*Index*.

ASCLEPIA, a feftival of Æfculapius the god of phyfic, obferved particularly at Epidaurus, where it was attended with a conteft between the poets and muficians, whence it was likewife called Ιερος Αγων, *the facred contention*.

ASCLEPIAD, in ancient poetry, a verfe compofed of four feet, the firft of which is a fpondee, the fecond a choriambus, and the two laft dactyls; or of four feet and a cæfura, the firft a fpondee, the fecond a dactyl, after which comes the cæfura, then the two dactyls; as, *Mæcenas atavis edite regibus*

ASCLEPIADES, one of the moft celebrated phyficians among the ancients, was a native of Prufa, in Bithynia; and practifed phyfic at Rome, under Pompey, 96 years before the Chriftian æra. He was the head of a new fect; and, by making ufe of wine and cold water in the cure of the fick, acquired a very great reputation. He wrote feveral books, which are frequently mentioned by Galen, Celfus, and Pliny; but they are now loft.

ASCLEPIADES, a famous phyfician under Hadrian, of the fame city with the former. He wrote feveral books concerning the compofition of medicines, both internal and external.

ASCLEPIAS, SWALLOW-WORT; A genus of the digynia order, belonging to the pentandria clafs of plants; and in the natural method ranking under the 30th order, *Contortæ*. The generic character is taken from five oval, concave, horn-like nectaria which are found in the flower. The

Species are 19; of which the following are the moft remarkable. 1. The alba, or common fwallow-wort, has a root compofed of many ftrong fibres connected at top like thofe of afparagus, from whence arife many ftalks, in number proportional to the fize of the roots, which grow two feet high, and are very flender at the top: the leaves are placed oppofite by pairs; the flowers are white, growing in umbels near the top of the ftalk, from whence are fent out fmaller umbels. After the flower is paft, the two germens become long pointed pods, inclofing many compreffed feeds lying imbricatim, which are crowned with a foft white down. It flowers in June, and the feeds ripen in September. It is a native of the fouth of France, Spain, and Italy. 2. The Syriaca, or greater Syrian dogfbane, is a perennial plant, which fends up feveral upright ftalks in the fpring, about two feet high, garnifhed with oval leaves growing oppofite; at the top of the ftalks the umbels of flowers are produced, which are of a bright purple colour, making a pretty appearance, but are not fucceeded by pods in England. 3. The curraffavica, or baftard ipecacuanha, is a native of the warm parts of of America. It rises to the height of five or six feet, with upright stems, and smooth oblong leaves placed opposite. Toward the top of the branches the umbels of flowers come out, which stand erect: the petals of the flowers are of a scarlet colour, and the horny nectariums in the middle are of a bright saffron colour, which make a pretty appearance; and there is a succession of flowers on the same plant from June to October. The flowers are succeeded by long taper pods, filled with seeds crowned with soft down, which ripen late in autumn. The first two species are hardy; but the last one is tender, and therefore must be preserved in a stove.

Medicinal Uses, &c. The root of the first species is used in medicine. It is reckoned by botanists a species of dogsbane; from all the poisonous sorts of which it may be distinguished, by yielding a limpid juice, whilst that of the others is milky. The root has a strong smell, especially when fresh, approaching to that of Valerian, or nard; the taste is at first sweetish and aromatic, but soon becomes bitterish, subacrid, and nauseous. This root is esteemed sudorific, diuretic, and emmenagogue: it is also frequently employed by the French and German physicians as an alexipharmic, and sometimes as a succedaneum to contrayerva, whence it has received the name of *contrayerva Germanorum*. Among us it is very rarely made use of: it appears from its sensible qualities to be a medicine of much the same kind with valerian, which is indisputably preferable to it. The root of the third species has been sometimes sent over from America instead of that of ipecacuanha, and mischievous effects have been produced by it. Those who cultivate this plant ought to be careful that none of its milky juice mix with any thing which is taken inwardly.

ASCODUTÆ, in antiquity, a sect of heretics, in the second century, who rejected the use of symbols and sacraments, on this principle, That incorporeal things cannot be communicated by things corporeal, nor divine mysteries by any thing visible.

ASCOLI, formerly *Asculum Apulum*, a pretty large and populous town of Italy, in the marche of Ancona, and territory of the church; it is a bishop's see, and seated on a mountain, at the bottom of which runs the river Fronto. E Lon. 15. 20. N. Lat. 42. 47.

Ascoli de Satriano, formerly *Asculum Picenum*, an episcopal city of Italy, in the kingdom of Naples; seated on a mountain. E. Long. 15. 5. N. Lat. 42. 8.

ASCOLIA, in Grecian antiquity, a festival celebrated by the Athenian husbandmen in honour of Bacchus, to whom they sacrifice a he-goat, because it destroys the vines (*Ovid Fast*. i. 357); and, to shew the greater indignity to an animal hated by Bacchus, the peasants, after having killed him, made a foot-ball of his skin. Virgil has beautifully described the occasion of the sacrifice, and manner of celebrating the festival, *Georg*. ii. 380.

ASCRIPTITII, or ADSCRIPTITII, were a kind of villains, who, coming from abroad, settle in the lands of some new lord, whose subjects or servants they commence; being so annexed to the lands, that they may be transferred and sold with the same. Ascriptitii is sometimes also used in speaking of aliens or foreigners newly admitted to the freedom of a city or country.

ASCRIPTITII was also used in the military laws for the recruits appointed to supply the losses of the legions, called also *Accensi*.

ASCRIVIUM (anc. geog.), a town of Dalmatia, on the Sinus Rhizicus (Pliny, Ptolemy): Now *Cattaro* (Harduin); the capital of the territory of Cattaro, in Venetian Dalmatia. E. Long. 19. 20. Lat. 45. 25.

ASCULUM APULUM (anc. geog.) a town of Apulia, much mentioned in the war with Pyrrhus (Florus, Plutarch): Now called *Ascoli*; a city of the Capitanata, in the kingdom of Naples. E. Long. 16. 30. Lat. 41. 15.

Asculum Picenum (anc. geog.), a town of the Piceni (Cæsar); and the capital (Florus): Now *Ascoli*, in the marche of Ancona, on the river Tronto. E. Long. 15. 5. Lat. 42 50.

ASCYRUM, PETER'S-WORT: A genus of the polyandria order, belonging to the polydelphia class of plants; and in the natural method ranking under the 20th order, *Rotaceæ*. The calyx consists of four leaves; the corolla has four petals; the filaments are numerous, and divided into four bundles. There are three species, the crux andreæ, the hypericoides, and the villosum, all natives of the West Indies or America, but possessing no property worthy of notice.

ASDRUBAL, the name of several Carthaginian generals. See CARTHAGE.

ASEKI, or ASEKAI, the name which the Turks give to the favourite sultanesses who have brought forth sons. These are greatly distinguished above others in their apartments, attendants, pensions, and honours. They have sometimes shared the government. The sultana who first presents the emperor with a male child, is reckoned the chief favourite, is called *buyuk aseki*, and ranks as a legitimate wife: though, from the time of Bajazet I. the sultans are forbid to marry by a public law, which Solyman II. violated in favour of Roxalana.

ASELLUS, in zoology, the trivial name of a species of oniscus. See ONISCUS.

ASGILL, (John), a late humorous writer, was bred to the law, and practised in Ireland with great success. He was there elected a member of the house of commons, but was expelled for writing a treatise on the possibility of avoiding death; and being afterwards chosen a member for the borough of Bramber in Sussex, he was also on the same account expelled the parliament of England. After this he continued 30 years a prisoner in the Mint, Fleet, and King's-bench; during which time he published a multitude of small political pamphlets, several of which were in defence of the succession of the house of Hanover, and against the Pretender. He died in the rules of the King's-bench, in the year 1738, when he was upwards of fourscore.

ASH, in botany. See FRAXINUS.

Ash-Hole, among chemists, is the lowest part of a furnace; and is intended to receive the ashes falling from the fire, and to give a passage to the air which is to be introduced into the furnace, to keep up the combustion.

Ash-Wednesday, the first day of Lent; supposed to have been so called from a custom in the church, of sprinkling ashes that day on the heads of penitents then admitted to penance. See LENT.

ASHBORN, a town in Derbyshire, seated between the rivers Dove and Compton, over which there is a stone bridge, in a rich soil. It is a pretty large town, though not so flourishing as formerly. W. Long. 1. 35. N. Lat. 53. 0.

ASHBURTON, a town in Devonshire. It sends two members to parliament, and is one of the four stannery towns. It is seated among the hills, which are remarkable for tin and copper; and has a very handsome church; as also a chapel, which is turned into a school. It gives title of Baron to Dunning the late solicitor-general, whose son now enjoys it. W. Long. 3. 10. N. Lat. 50. 30.

ASHBY DE LA ZOUCH a market-own in Leicestershire, situated in W. Long. 1. 20. N. Lat. 52. 40. It had a castle, which was long in the possession of the family of de la Zouch. It afterwards fell into the hands of Edward IV. who granted it to Sir Edward Hastings, created baron Hastings, with licence to make a castle of the manorhouse, to which he adjoined a very high tower. It was demolished in 1648; but a great part of the tower is still standing. It now belongs to the Earl of Huntingdon.

ASHDOD, or AZOTUS. See AZOTUS.

ASHES, the earthy particles of combustible substances after they have been burnt.

If the ashes are produced from vegetable bodies, they contain a considerable quantity of fixed salt, blended with the terrene particles: and from these ashes the fixed alkaline salts called *pot-ash*, *pearl-ash*, &c. are extracted. See POTASH, &c.

The ashes of all vegetables are vitrefiable, and found to contain iron. They are also excellent manure for cold and wet grounds. See AGRICULTURE, n° 20.

Several religious ceremonies depend upon the use of ashes. St Jerome relates, that the Jews in his time rolled themselves in ashes, as a sign of mourning. To repent in sackcloth and ashes, is a frequent expression in Scripture for mourning and being afflicted for our sins. There was a sort of lye and lustral water made with the ashes of an heifer sacrificed upon the great day of expiation; the ashes whereof were distributed to the people, and this water was used in purifications as often as any touched a dead body, or was present at funerals, (Numb. xix. 17.) Tamar after the injury received from her brother Amnon, covered her head with ashes, (2 Sam. xiii. 19.) The Psalmist in great sorrow says, that he had eaten ashes as if it were bread, (Ps. cii. 9.); which, however is to be considered as an hyperbole. He sat on ashes, he threw ashes on his head; his food, his bread, was spoiled with the ashes wherewith he was covered.

The ancient Persians had a sort of punishment for some great criminals, which consisted in executing them in ashes. The criminal was thrown headlong from a tower 50 cubits high, which was filled with ashes to a particular height, (2 Mac. xiii. 5, 6.) The motion which the criminal used to disengage himself from this place, plunged him still deeper into it, and this agitation was farther increased by a wheel which stirred the ashes continually about him till at last he was stifled.

ASHFORD, a market-town of Kent, situated about 12 miles south-west of Canterbury, in E. Long. 45. and N. Lat. 51. 15.

ASHLAR, a term used among builders, by which they mean common or free stones, as they come out of the quarry, of different lengths and thicknesses.

ASHLERING, among builders, signifies quartering, to lath to, in garrets, about two and a half, or three feet high, perpendicular to the floor, up to the under side of the rafters.

ASHMOLE (Elias), a great antiquary and herald, founder of the Ashmolean musæum at Oxford, was born at Litchfield in Staffordshire, 1617. In the early part of his life, he practised in the law; and in the civil war had a captain's commission under the king, and was also comptroller of the ordnance. He married the lady Mainwaring in 1649, and settled at London; where his house was frequented by all the learned and ingenious men of the time. Mr Ashmole was a diligent and curious collector of manuscripts. In the year 1650, he published a treatise written by Dr Arthur Dee, relating to the philosopher's stone; together with another tract on the same subject, by an unknown author. About the same time he was busied in preparing for the press a complete collection of the works of such English chemists as had till then remained in manuscript. This undertaking cost him great labour and expence; and at length the work appeared, towards the close of the year 1652. He proposed at first to have carried it on to several volumes; but he afterwards dropped this design, and seemed to take a different turn in his studies. He now applied himself to the study of antiquity and records: he was at great pains to trace the Roman road, which in Antoninus's Itinerary is called *Bennevanna*, from Weedon to Litchfield, of which he gave Mr Dugdale an account in a letter. In 1658, he began to collect materials for his history of the order of the garter, which he lived to finish, and thereby did no less honour to the order than to himself. In September following, he made a journey to Oxford, where he set about giving a full and particular description of the coins presented to the public library by Archbishop Laud.

Upon the restoration of King Charles II. Mr Ashmole was introduced to his majesty, who received him very graciously; and on the 18th of June 1660, bestowed on him the place of Windsor herald A few days after, he appointed him to give a description of his medals, which were accordingly delivered into his possession, and King Henry VIII's closet was assigned for his use. On the 15th of February Mr Ashmole was admitted a fellow of the royal society: and, on the 9th of February following, the king appointed him secretary of Surinam, in the West Indies. On the 19th of July 1699, the university of Oxford, in consideration of the many favours they had received from Mr Ashmole, created him Dr of physic by diploma, which was presented to him by Dr Yates, principal of Brazen Nose college. On the 8th of May 1672, he presented his "Institution, laws, and ceremonies of the most noble order of the garter," to the king; who received it very graciously, and, as a mark of his approbation, granted him a privy seal for L.400 out of the custom of paper. On the 26th of January 1679, a fire broke out in the Middle Temple, in the next chamber to Mr. Ashmole's, by which he lost a noble library, with a collection of 9000 coins, ancient and modern, and a vast repository of seals, charters, and other antiquities and curiosities; but

Asia. but his manuscripts and his most valuable gold medals were luckily at his house at Lambeth. In 1683, the university of Oxford having finished a magnificent repository near the theatre, Mr Ashmole sent thither his curious collection of rarities; which benefaction was considerably augmented by the addition of his manuscripts and library at his death, which happened at Lambeth, the 18th of May, in the 76th year of his age. He was interred in the church of Great-Lambeth, in Surry, on the 26th of May 1692, and a black marble stone laid over his grave, with a Latin inscription.

Besides the works which we have mentioned, Mr Ashmole left several which were published since his death, and some which remain still in manuscript.

ASIA, is one of the three general parts of our continent, and one of the four of the whole earth. It is separated from Europe by the Mediterranean sea, the Archipelago, the Black Sea, the Palus Meotis, the Don, and the Dwina, which fall into the White Sea; and from Africa, by the Arabic Gulph or Red Sea, and the Istmus of Suez. All the other parts are surrounded by the ocean. The late discoveries show that it does not join to America, though it extends very near it: (See America, n° 105.). It is situated between 44 and 196 degrees of east longitude, and 1 and 74 degrees of north latitude. From the Dardanelles to the most eastern shore of Tartary, it is 4740 miles in length; and from the most southern point of Malacca to the most northern point of Nova Zembla, it is 4380 miles in breadth.

This vast extent of territory was successively governed in past times by the Assyrians, the Medes, the Persians, and the Greeks; but the immense regions of India and China were little known to Alexander, or the conquerors of the ancient world. Upon the decline of those empires, great part of Asia submitted to the Roman arms; and afterwards, in the middle ages the successors of Mahomet, or, as they are usually called, Saracens, founded in Asia, in Africa, and in Europe, a more extensive empire than that of Cyrus, Alexander, or even the Roman when in its height of power. The Saracen greatness ended with the death of Tamerlane; and the Turks, conquerors on every side, took possession of the middle regions of Asia, which they still enjoy. Besides the countries possessed by the Turks and Russians, Asia contains at present three large empires, the Chinese, the Mogul, and the Persian; upon which the lesser kingdoms and sovereignties of Asia generally depend. The prevailing form of government in this division of the globe is absolute monarchy. If any of them can be said to enjoy some share of liberty, it is the wandering tribes, as the Tartars and Arabs. Many of the Asiatic nations, when the Dutch first came among them, could not conceive how it was possible for any people to live under any other form of government than that of a despotic monarchy. Turkey, Arabia, Persia, part of Tartary, and part of India, profess Mahometanism. The Persian and Indian Mahometans are of the sect of Hali, and the others of that of Omar; but both own Mahomet for their law-giver, and the Koran for their rule of faith and life. In the other parts of Tartary, India, China, Japan, and the Asiatic Islands, they are generally heathens and idolaters. Jews are to be found every where in Asia. Christianity, though planted here with wonderful rapidity by the apostles and primitive fathers, suffered an almost total eclipse by the conquests of the Saracens, and afterwards of the Turks. Incredible indeed have been the hazards, perils, and sufferings of popish missionaries, to propagate their doctrines in the most distant regions and among the grossest idolaters; but their labours have hitherto failed of success, owing in a great measure to their own avarice, and the avarice and profligacy of the Europeans, who resort thither in search of wealth and dominion.

Asia may be divided into the following parts: Turkey in Asia, Arabia, Persia, the Mogul's Empire, with the two peninsulas of the Indies; Tibet, China, and Corea; Great and Little Buckaria, with Korasin; Tartary, Siberia, and the islands. The principal languages spoken in Asia are, the modern Greek, the Turkish, the Russian, the Tartarian, the Persian, the Arabic, the Malayan, the Chinese, and the Japanese. The European languages are also spoken upon the coasts of India and China.

Asia is looked upon as that part of the world which, of all others, has been most peculiarly distinguished by heaven. There it was the first man was created; there the patriarchs lived, the law was given to Moses, and the greatest and most celebrated monarchies were formed; from thence the first founders of cities and nations in other quarters of the world brought their colonies. Lastly, in Asia, Jesus Christ appeared: there it was that he wrought the salvation of mankind, that he died and rose again; and from thence it is that the light of the gospel was diffused over all the world. Laws, arts, sciences, and religion, almost all had their original in Asia.

As Asia exceeds the other two parts of our continent, Europe and Africa, so it is superior to them in the serenity of its air, the fertility of its soil, the deliciousness of its fruits, the fragrancy and balsamic qualities of its plants, spices, and gums; the salubrity of its drugs; the quantity, variety, beauty, and value of gems; the richness of its metals, and the fineness of its silks and cottons. A great change indeed hath happened in that part of it called Turkey, which hath lost much of its ancient splendor, and from the most populous and best cultivated spot in Asia, is become a wild and uncultivated desart. The other parts of Asia continue much in their former condition; the soil being as remarkable for its fertility, as most of the inhabitants for their indolence, effeminacy, and luxury. This effeminacy is chiefly owing to the warmth of the climate, though in some measure heightened by custom and education; and the symptoms of it are more or less visible as the several nations are seated nearer or farther from the north. Hence the Tartars, who live near the same latitudes with us, are as brave, hardy, strong, and vigorous, as any European nation. What is wanting in the robust frame of their bodies among the Chinese, Mogul-Indians, and all the inhabitants of the more southern regions, is in a great measure made up to them by the vivacity of their minds, and ingenuity in various kinds of workmanship, which our most skilful mechanics have in vain endeavoured to imitate.

The chief rivers of Asia are, the Euphrates and Tigris,

gris, in Turkey; the Indus and Ganges, in India; the Kiang and Hoang-ho, in China: the Sir Amu and Wolga, in Western Tartary; the Saghalia Ula or Amur, in Eastern Tartary; the Irtish, Oby, Jenisea, and Lena, in Siberia. The lakes are, that prodigious one called the *Caspian Sea*; and near that another very large one, but lately known to us, called *Aral*, or the lake of eagles. The Baykal is in Siberia, the Kokonor near Tibet, and the Tong Ping in China. The chief mountains are, the Taurus in Turkey and Persia; the Imaus, between India and Tibet; and the Altay, in Tartary.

The Asiatic islands are very numerous, insomuch that some reckon 150,000; but of this there is no certainty. However, they may be divided into those of the east, west, south, and south-east. Those that lie on the east of Asia are, the islands of Jesso or Yedso, and Japan, with several small ones on the coast of Korea, the island of Formosa, and the Phillippines. Those on the west are, the island of Cyprus, in the Mediterranean; Scanderoon, off Natolia, and the isle of Rhodes, off Phischio, on the same coast. Those on the south are, the isles of the Maldives, in the Indian Sea; the isle of Ceylon, off cape Komorin; with a great many small ones in the gulph of Bengal. Those on the south-east are, the isles of Sandi, as Sumatra, the isles of Java, Borneo, &c. the Moluccas, the isles of Kumbava, Timor, &c.

Asia Minor, or *Lesser Asia*; the same with Natolia. See Natolia.

ASIARCHÆ, (termed by St Paul, *Chief of Asia*, Acts xix. 31.) were the Pagan Pontiffs of Asia, chosen to superintend and have the care of the public games; which they did at their own expence: for which reason they were always the richest and most considerable men of the towns.

ASIDE, in the drama, something said by an actor, which some, or even all the other actors present, are supposed not to hear; a circumstance justly condemned as being unnatural and improbable.

ASIITO, a town of Italy, in Perugia, and in the Pope's territories. E. Long. 23. 40. N. Lat. 43. 0.

ASILIUS, or Honey-fly, a genus of insects belonging to the order of insecta diptera. It has two wings; and a horny, strait, two-valved beak. There are 17 species of this insect. Many of them wound in a very painful manner, and are particularly troublesome to cattle in low meadows; others of them are quite harmless. See Plate LVI.

ASINARA, an island of Italy, on the western coast of Sardinia. E. Long. 8. 30. N. Lat. 41. 0.

ASINIUS (Pollio), consul and Roman orator, distinguished himself under Augustus by his exploits and his literary works. He is frequently mentioned with praises by Horace and Virgil, and is said to have collected the first library at Rome. He died at Frescati, at 80 years of age.

ASIONGABER, Esiongeber, or Eziongeber a town of Arabia Petræa, on the bay of Elath, a part of the Arabian Gulf; the dock or station of the ships of Solomon and Jehosaphat; an ancient town, mentioned also by Moses. It was afterwards called *Berenice* (Josephus).

ASISIA, or Assisia, a town of Liburnia (Ptolemy, Antonine), now in ruins, but exhibiting many monuments of antiquity. It is the Assesia or Asseria of Pliny. This author, after having specified the Liburnian cities that were obliged to attend the congress or diet of Scardona, adds to the catalogue the free Asserians, *immunesque Asseriates*; and this people, who created their own magistrates, and were governed by their own municipal laws, were no doubt more rich and powerful than their neighbours.

The vestiges of the walls of Asseria that still remain, are a sufficient proof of this; for their circumference is clearly distinguishable above ground, and measures 3600 Roman feet. The space inclosed by them forms an oblong polygon, and they are built with common Dalmatian marble; but not taken from the hill on which they stand, for that furnishes only soft stone. The walls are invested, both inside and out, with this marble: some of the stones are ten feet long, and they are all of considerable dimensions. The thickness of these fortifications is commonly about eight feet: but at the narrowest extremity, which falls towards the foot of the hill, they are eleven feet thick; and, in some parts, their height still above ground reaches to near 30 feet. An antiquary, or even a simple lover of the fine arts, or of erudition, the Abbe Fortis observes, cannot help wishing at Podgraje (the modern name of Asseria), that some powerful hand *quicquid sub terra est in apricum proferit*: and such a wish becomes stronger when he reflects, that since the destruction of that city no search has ever been made under ground, with a view to discover any thing curious; and yet these walls without doubt inclose a valuable deposite of antiquities, thrown down in heaps, who knows by what cause; perhaps naturally, by an earthquake, or perhaps by a sudden inundation of barbarians, which is still worse. The gate now demolished, the considerable height of the walls to be seen in several places from without, some pieces of thick walls that still appear levelled to the ground among the bushes, are circumstances which give ground to hope that many costly monuments might be recovered out of these ruins. The magnificence of the remaining wall, and the many pieces of well-cut stone and fine marble scattered over the contiguous fields, afford sufficient proof that both good taste and grandeur once flourished in that country. In the midst of the rubbish which covers the remains of Asseria, the parish church of the little village stands insolated; it is built of broken pieces of ancient ruins, taken as they happened to be nearest, mixed with mutilated inscriptions, and fragments of noble cornices.

ASKELON. See Ascalon.

ASKERON, a place five miles from Doncaster, noted for a medicinal spring. It is a strong sulphureous water, and is slightly impregnated with a purging salt. It is recommended internally and externally in strumous and other ulcers, scabs, leprosy, and similar complaints. It is good in chronic obstructions, and in cases of worms and foulness of the bowels.

ASISIO, or Asitio, a city of the Pope's territories in Italy, situated about 16 miles east of Perugia. E. Long. 13. 35. N. Lat. 43.

ASKRIG, a town in the N. Riding of Yorkshire. W. Long. 0. 5. N. Lat. 53. 50.

ASLANI, in commerce, a silver coin, worth from 115 to 120 aspers. See Asper.

Plate LIX.


Asia
PART of EUROPE
RUSSIAN EMPIRE
SIBERIA
MEDITERRANEAN SEA
BLACK SEA
CASPIAN SEA
ASTRACHAN
CALMUKS
ELUTH
INDEPENDENT TARTARY
CHINESE TARTARY
MANCHEWS
BUKARIA
TIBET
CHINA
COREA
SEA OF COREA
JAPAN
YEDSO
Company's Land
DE GAMA'S LAND
PERSIA
ARABIA
RED SEA
MOGUL EMPIRE
INDIA
ARABIAN SEA
BAY OF BENGAL
PHILIPINE ISLANDS
LUCONIA
Formosa
MOLUCCA ISLANDS
Gilolo
BORNEO
CELEBES
SUMATRA
JAVA
SUNDA ISLANDS
NEW GUINEA
New Britain
Terra de Papos
New Philippines
Ladrone Islands
Guam
Tropic of Cancer
Equinoctial Line
THE INDIAN OR EASTERN OCEAN
PART OF AFRICA
Ceylon I.
Maldive Island
Str. of Babelmandel
Socotra I.
C. Guardafui
Yellow Sea
Arctic Circle
Nova Zembla

ASMONEUS, or ASSAMONEUS, the father of Simon, and chief of the Asmoneans, a family that reigned over the Jews during 126 years.

ASNA, or ESNA, a town in Upper Egypt, seated upon the Nile, believed by some authors to be the ancient Syena, though others say the ruins of it are still to be seen near Assuan. It is so near the cataracts of the Nile, that they may be heard from thence. It contains several monuments of antiquity; and among the rest an ancient Egyptian temple, pretty entire, all painted throughout, except in some places that are effaced by time. The columns are full of hieroglyphic figures. This superb structure is now made use of for a stable, wherein they put oxen, camels, and goats. A little way from thence are the ruins of an ancient nunnery, said to be built by St Helena, surrounded with tombs.—Asna is the principal town in these parts, and the inhabitants are rich in corn and cattle. They drive a considerable trade into Lower Egypt and Nubia, by means of the Nile, and also by the caravans that pass over the Desart. The inhabitants are all Arabs, except about 200 Copts, the ancient inhabitants, and a sort of Christians. They are under the government of the Turks, who have a cadi, and the Arabs have two sheriffs of their own nation. E. Long. 31. 40. N. Lat. 28. 15.

ASOLA, a town of the Bressan in Italy, belonging to the republic of Venice. E. Long. 14. 18. N. Lat. 45. 15.

ASOLO, a town of Italy, in the Trevisan, seated on a mountain 17 miles north-west of Trevisan, and 10 north-east of Bassano. E. Long. 12. 2. N. Lat. 45. 49.

ASOPH, a town of Coban Tartary, in Asia, seated on the river Don, near its mouth, a little to the east of the Palus Mœotis, or Sea of Azoph. It has been several times taken and retaken of late years; but in 1739, the contending powers agreed that the fortifications should be demolished, and the town remain under the dominion of Russia. E. Long. 41. 30. N. Lat. 47. 18.

ASOPUS, a river of Phrygia Major, which, together with the Lycus, washes Laodicea, (Pliny).—Another of Bœotia, which running from mount Cithæron, and watering the territory of Thebes, separates it from the territory of Platæa, and falls with an east course into the Euripus, at Tanagra. On this river Adrastus king of Sicyon built a temple to Nemesis, thence called *Adrasteia*. From this river Thebae came to be surnamed *Asopides*, (Strabo). It is now called *Asopo*.—A third Asopus, a river of Peloponnesus, which runs by Sicyon, (Strabo); and with a north-west course falls into the Sinus Corinthiacus, to the west of Corinth.—A fourth, a small river of the Locri Epicnemidii, on the borders of Thessaly, (Pliny); rising in Mount Oeta, and falling into the Sinus Maliacus.

ASOPUS, a town of Laconica, (Pausanias); on the Sinus Laconicus, with a port in a peninsula, between Boæ to the east, and the mouth of the Eurotas to the west. The citadel only remains standing, now called by the sailors *Castel Rampano*.

ASOR, or HAZOR (anc. geog.), a town of the tribe of Judah, to the south-west, on the borders of Ascalon, (Joshua); as also Hasor-Hadata, translated by the seventy Ασωρη Καινη (id).—Another Asor, Asorus, or Hazor, a town of Galilee; called the capital of all the kingdoms to the north of Palestine. It was taken by Joshua; the inhabitants were put to the sword, and their houses burnt. It was afterwards rebuilt (Judges, 1 Sam.); but remained still in the hands of the Canaanites, though in the lot of the tribe of Naphthali, (Joshua). It lay to the north of the Lacus Samachonites, called in Scripture the *Waters of Merom*, (Josephus).

ASOW, a celebrated and important fortress of Russia, once a place of considerable trade, but now demolished. It was situated in the district of Bachmut, near the place where the Greeks many centuries ago built the city of Tanais, which was very famous for its trade, and underwent many vicissitudes. The Genoese, who settled a trade with Russia soon after the discovery of Archangel by Captain Chancellor, became masters of this place, and gave it the name of *Tana*, or *Catana*: but the Tartars, who were very powerful in these parts, seem to have been in possession of it long before; for, as Busching informs us, there are Asow coins yet extant, on which is the name of *Taktamyss-Kan*. From the Genoese it fell into the hands of the Turks, lost its trade, and became an inconsiderable town. In 1637, it was taken by the Cossacks, who defended it against the Turks in 1641, and next year set fire to it, and blew it up. The Turks rebuilt it with strong fortifications. The Russians laid claim to it in 1672, and took it in 1696; but, by the treaty of Pruth in 1711, it was restored to the Turks. In 1736, the Russians became masters of Asow; but by the treaty of Belgrade they were obliged to relinquish it, and entirely destroy the place.

ASP, in natural history, a small poisonous kind of serpent, whose bite gives a speedy but easy death. It is said to be thus denominated from the Greek ασπις, *shield*, in regard to the manner of its lying convolved in a circle, in the centre of which is the head, which it exerts, or raises, like the umbo or umbilicus of a buckler. This species of serpent is very frequently mentioned by authors; but so carelessly described, that it is not easy to determine which, if any of the species known at present, may properly be called by this name. It is said to be common in Africa, and about the banks of the Nile; and Bellonius mentions a small species of serpent which he had met with in Italy, and which had a sort of callous excrescence on the forehead, which he takes to have been the aspis of the ancients. It is with the asp that Cleopatra is said to have dispatched herself, and prevented the designs of Augustus, who intended to have carried her captive to adorn his triumphal entry into Rome. But the fact is contested: Brown places it among his vulgar errors. The indications of that queen's having used the ministry of the asp, were only two almost insensible pricks found in her arm; and Plutarch says it is unknown what she died of. At the same time, it must be observed, that the slightness of the pricks found in her arm furnishes no presumption against the fact; for no more than the prick of a needle-point dipt in the poison was necessary for the purpose. See the article SERPENT.

Lord Bacon makes the asp the least painful of all the instruments of death. He supposes it to have an affinity to opium, but to be less disagreeable in it operation; and his opinion seems to correspond with the

 account,

accounts of most writers, as well as with the effects described to have been produced upon Cleopatra; for which see the article already referred to.

The ancients had a plaster called δι Ασπιδων, made of this terrible animal, of great efficacy as a discutient of strumæ and other indurations, and used likewise against pains of the gout. The flesh and skin, or exuviæ, of the creature, had also their share in the ancient materia medica.

ASPA, a town of Parthia, (Ptolemy); now *Ispahan*, (Holstenius). In Ptolemy the latitude seems to agree, being 33°; but whether the longitude does, is a question. E. Long. 51. Lat. 32. 30.

ASPALATHUS, AFRICAN BROOM: A genus of the decandria order, belonging to the diadelphia class of plants; and in the natural method raking under the 32d order, *Papilionaceæ*. The calyx consists of 5 divisions: the pod is oval, and contains 2 seeds. Of this genus there are 19 species; all of which are natives of warm climates, and must be preserved in stoves by those who would cultivate them here. The rose-wood, whence the oleum rhodii is obtained, is one of the species, but of which we have yet had no particular description. The wood is heavy, oleaginous, somewhat sharp and bitter to the taste, of a strong smell and purple colour. It is called *rose-wood* or *lignum Rhodium*, either on account of its sweet smell, or of its growth in the island of Rhodes. It was anciently in much repute as an astringent, strengthener, and drier; but it is now disused in internal practice. It affords an oil of an admirable scent, reputed one of the best of perfumes: it is chiefly used in scenting pomatums and liniments.

ASPARAGUS, SPARAGUS, SPERAGE, or SPARROWGRASS: A genus of the monogynia order, belonging to the hexandria class of plants; and in the natural method ranking under the 11th order, *Sarmentaceæ*. The calyx is quinquepartite, and erect; the 3 inferior petals are bent outwards; the berry has 3 cells, and contains 2 seeds.—The species are 10; but the only one cultivated in the gardens is that with an upright herbaceous stalk, bristly leaves, and equal stipula, or the common asparagus. The other species are kept only in the gardens of the curious for the sake of variety.

Culture. The garden asparagus is with great care cultivated for the use of the table. The propagation of this useful plant is from seed; and as much of the success depends upon the goodness of the seed, it is much better to save it than to buy it at the shops. The manner of saving it is this: Mark with a stick some of the fairest buds; and when they are run to berry, and the stalks begin to dry and wither, cut them up; rub off the berries into a tub, and pouring water upon them, rub them about with your hands; the husks will break and let out the seed, and will swim away with the water in pouring it off; so that in repeating this two or three times, the seeds will be clean washed, and found at the bottom of the tub. These must be spread on a mat to dry, and in the beginning of February must be sown on a bed of rich earth. They must not be sown too thick, and must be trod into the ground, and the earth raked over them smooth: the bed is to be kept clear of weeds all the summer; and in October, when the stalks are withered and dry, a little rotten dung must be spread half an inch thick over the whole surface of the bed. The spring following, the plants will be fit to plant out for good; the ground must therefore be prepared for them by trenching it well, and burying a large quantity of rotten dung in the trenches, so that it may lie at least six inches below the surface of the ground: when this is done, level the whole plot exactly, taking out all the loose stones. This is to be done just at the time when the asparagus is to be planted out; which must be in the beginning of March, if the soil is dry and the season forward; but in a wet soil it is better to wait till the beginning of April, which is about the season that the plants are beginning to shoot. The season being now come, the roots must be carefully taken up with a narrow-pronged dunk-fork, shaking them out of the earth, separating them from each other, and observing to lay all their heads even for the more convenient planting them; which must be done in this manner. Lines must be drawn, at a foot distance each, straight across the bed; these must be dug into small trenches of six inches deep, into which the roots must be laid, placing them against the sides of the trench with their buds in a right position upwards, and so that, when the earth is raked over them, they may be two inches under the surface of the ground. Between every four rows a space of two feet and a half should be left for walking in, to cut the asparagus. When the asparagus is thus planted, a crop of onions may be sown on the ground, which will not at all hurt it. A month after this, the asparagus will come up, when the crop of onions must be thinned, and the weeds carefully cleared away. About August the onions will be fit to pull up. In October following, cut off the shoots of the asparagus within two inches of the ground, clear well all weeds away, and throw up the earth upon the beds, so as to leave them five inches above the level of the alleys. A row of colworts may be planted in the middle of the alleys, but nothing must be now sown on the beds. In the spring the weeds must be hoed up, and all the summer the beds kept clear of weeds. In October they must be turned up, and earthed again, as the preceeding season. The second spring after planting, some of the young asparagus may be cut for the table. The larger shoots should only be taken, and these should be cut at two inches under ground, and the beds every year managed as in the second year. But as some people are very fond of early asparagus, the following directions are given by which it may be obtained any time in winter: Plant some good roots at one year old in a moist rich soil, about eight inches apart; the second and third years after planting, they will be ready to take up for the hot-beds; these should be made pretty strong, about three feet thick, with new stable-dung that has fermented a week or more; the beds must be covered with earth six inches thick; then against a ridge made at one end, begin to lay in your plants, without trimming or cutting the fibres, and between every row lay a little ridge of fine earth, and proceed thus till the bed is planted; then cover the bed two inches thick with earth, and encompass it with a straw-band, and in a week, or as the bed is in the temper, put on the frames and glasses, and lay on three inches thick of fresh

fresh earth over the beds, and give them air and add fresh heat to them as it requires. These beds may be made from November till March, which will last till the natural grass comes on.

Medicinal Uses. The roots have a bitterish mucilaginous taste, inclining to sweetness; the fruit has much the same kind of taste; the young shoots are more agreeable than either. Asparagus promotes appetite, but affords little nourishment. It gives a strong ill smell to the urine in a little time after eating it, and for this reason chiefly is supposed to be diuretic: it is likewise esteemed aperient and deobstruent; the root is one of the five called *opening roots*. Some suppose the shoots to be most efficaceous; others, the root; and others the bark of the root. Stahl is of opinion that none of them have any great share of the virtues usually ascribed to them. Asparagus appears from experience to contribute very little either to the exciting of urine when suppressed, or increasing its discharge; and in cases where aperient medicines generally do service, this has little or no effect.

ASPASIA *of* MILETUS, a courtezan, who settled at Athens under the administration of Pericles, and one of the most noted ladies of antiquity. She was of admirable beauty; yet her wit and eloquence, still more than her beauty, gained her extraordinary reputation among all ranks in the republic. In eloquence she surpassed all her contemporaries, and her conversation was so entertaining and instructive, that notwithstanding the dishonourable commerce she carried on in female virtue, persons of the first distinction, male and female, resorted to her house as to an academy: she even numbered Socrates among her hearers and admirers. She captivated Pericles in such a manner, that he dismissed his own wife, in order to espouse her; and, by her universal knowledge, irresistible elocution, and intriguing genius, she in a great measure influenced the administration of Athens. She was accused of having excited, from motives of personal resentment, the war of Peloponnesus; yet, calamitous as that long and obstinate conflict proved to Greece, and particularly to Athens, it may be suspected that Aspasia occasioned still more incurable evils to both. Her example, and still more her instructions, formed a school at Athens, by which her dangerous profession was reduced into a system. The companions of Aspasia served as models for painting and statuary, and themes for poetry and panegric. Nor were they merely the objects, but the authors of many literary works, in which they established rules for the behaviour of their lovers, particularly at table; and explained the art of gaining the heart and captivating the affections. The dress, behaviour, and artifices of this class of women, became continually more seductive and dangerous; and Athens thenceforth remained the chief school of vice and pleasure, as well as of literature and philosophy.

ASPASIA, among ancient physicians, a constrictive medicine for the *pudenda muliebria*. It consisted only of wool, moistened with an infusion of unripe galls.

ASPATICUM, (from ασπαζομαι, "I salute," in ecclesiastical writers), a place, or apartment, adjoining to the ancient churches, wherein the bishop and Presbyters sat, to receive the salutations of the persons who came to visit them, desire their blessing, or consult them on business.—This is also called *aspaticum diaconicum, receptorium, metatorium,* or *mesatorium,* and *salutatorium;* in English, "greeting-house."

ASPECT, in astronomy, denotes the situation of the planets and stars with respect to each other.

There are five different aspects. 1. Sextile aspect is when the planets or stars are 60° distant, and marked thus ✱. 2. The quartile, or quadrate, when they are 90° distant, marked □. 3. Trine, when 120° distant, marked △. 4. Opposition, when 180° distant, marked ☍. And, 5. Conjunction, when both in the same degree, marked ☌.

Kepler, who added eight new ones, defines aspect to be the angle formed by the rays of two stars meeting on the earth, whereby their good or bad influence is measured: for it is to be observed, that these aspects being first introduced by astrologers, were distinguished into benign, malignant, and indifferent; the quartile and opposition being accounted malign; the trine and sextile, benign or friendly; and the conjunction indifferent.

ASPEN-TREE, in botany. See POPULUS.

ASPER, in grammar, an accent peculiar to the Greek language, marked thus (ʽ); and importing, that the letters over which it is placed ought to be strongly aspirated, or pronounced as if an *h* were joined with them.

ASPER, or *Aspre*, in commerce, a Turkish coin, three of which make a MEDINE.

ASPERA ARTERIA, in anatomy, the same with the windpipe or trachea. See ANATOMY, n° 116.

ASPERIFOLIATE, or ASPERIFOLIOUS, among botanists, such plants as are rough-leaved, having their leaves placed alternately on their stalks, and a monopetalous flower divided into five parts.—They constitute an order of plants in the *Fragmenta methodi naturalis* of Linnæus, in which are these genera, viz. tournefortia, cerinthe, symphytum, pulmonaria, anchusa, lithospermum, myosotis, heliotropium, cynoglossum, asperugo, lycopsis, echium, borrago: *magis minusve oleraceæ, mucilaginosæ, & glutinosæ sunt.* Lin. In the present system, these are among the pentandria monogynia.

ASPERIFOLIÆ PLANTÆ, rough-leaved plants. The name of a class in Hermanus, Boerhaave, and Ray's methods, consisting of plants which have four naked seeds, and whose leaves are rough to the touch.

In Tournefort's System, these plants constitute the third section or order of the second class; and in Linnæus's Sexual Method, they make a part of the pentandria monogynia.

ASPERITY, the inequality of the surface of any body, which hinders the hand from passing over it freely.—From the testimony of some blind persons, it has been supposed that every colour hath its particular degree of asperity: though this has been denied by others. See the article BLIND.

ASPEROSA, a town of Turkey, in Europe; it is a bishop's see, situated on the coast of the Archipelago. E. Long. 25. 20. N. Lat. 40. 58.

ASPERUGA, SMALL WILD BUGLOSS, in botany: A genus of the pentandria mongynia class; and in the natural method ranking under the 49th order, *Asperifoliæ*. The calyx of the fruit is compressed, with folds flatly parallel, and sinuous. There are two species, viz. the procumbens, or wild buglofs, a native of Bri-

Asperula, Asphaltites

Britain; and the Egyptiaca, a native of Egypt. Horses, goats, sheep, and swine eat the first species; cows are not fond of it.

ASPERULA, WOODROOF: A genus of the monogynia order, belonging to the hexandria class of plants; and in the natural method ranking under the 47th order, *Stellatæ*. The corolla is infundibuliform; and the capsule contains two globular seeds. There are two species, the cynanchica and the odorata. Both of them grow wild in Britain, so are seldom admitted into gardens. The first is found on chalky hills. The latter is a low umbelliferous plant, growing wild in woods and copses, and flowering in May. It has an exceeding pleasant smell, which is improved by moderate exsiccation; the taste is subsaline, and somewhat austere. It imparts its flavour to vinous liquors. Asperula is supposed to attenuate viscid humours, and strengthen the tone of the bowels; it is recommended in obstructions of the liver and biliary ducts, and by some in epilepsies and palsies; modern practice has nevertheless rejected it. The smell of it is said to drive away ticks and other insects. The roots of the first are used in Sweden to dye red.

ASPHALTITES, so called from the great quantity of bitumen it produces; called also the *Dead Sea*, and from its situation, the *East Sea*; the *Salt Sea*, the *Sea of Sodom*, the *Sea of the Desart*, and the *Sea of the Plain*, by the sacred writings: A lake of Judea.

Many things have been said and written of this famed, or, if they were indeed true, rather infamous lake; such as that it arose from the submersion of the vale of Siddim, where once stood, as is commonly reported, the three cities which perished in the miraculous conflagration, with those of Sodom and Gomorrah, for their unnatural and detestable wickedness: on which account this lake has been looked upon as a lasting monument of the just judgment of God, to deter mankind from such abominations. Hence it is added, that the waters of the lake are so impregnated with salt, sulphur, and other bituminous stuff, that nothing will sink or live in it; and that it casts such stench and smoke, that the very birds die in attempting to fly over it. The description likewise of the apples that grew about, fair without, and only ashes and bitterness within, were looked upon as a farther monument of God's anger. So likewise the description which many travellers give not only of the lake, but of all the country round about, of the whole appearing dreadful to behold, all sulphureous, bituminous, stinking, and suffocating: and lastly, what hath been farther affirmed of the ruins of the five cities being still to be seen in clear weather, and having been actually seen in these latter times; all these surprising things, and ill-grounded notions, tho' commonly, and so long, received among Christians, have been of late so much exploded, not only by the testimony of very credible witnesses, but even by arguments drawn from Scripture, that we must give them up as inventions, unless we will suppose the face and nature of all these to have been entirely changed. Those, in particular, of bodies not sinking in the water, and of birds being stifled by the exhalations of it, appear now false in fact. It is true, the quantity of salt, alum and sulphur, with which it is impregnated, render it so much specifically heavier (Dr Pococke says one-fifth) than fresh water, that bodies will not so easily sink: yet that author and others, assure us, they have swam and dived in it; and, as to the birds, we are told likewise, that they will fly over it without any harm. To reconcile these things with the experiments which Pliny * tells us had been made by Vespasian, is impossible, without supposing that those ingredients have been since much exhausted, which is not at all improbable; such quantities of them, that is, of the bitumen and salt, having been all along, and being still taken off, and such streams of fresh water continually pouring into it, as may reasonably be supposed to have considerably diminished its gravity and denseness. For, with respect to its salt, we are told, the Arabs made quantities of it from that lake, in large pits about the shores, which they fill with that water, and leave to be christalized by the sun. This salt is in some cases much commended by Galen, as very wholesome, and a strengthener of the stomach, &c. on account of its unpleasant bitterness.

* *Nat. Hist.* lib. v. cap. 15.

What likewise relates to the constant smoke ascending from the lake, its changing the colour of its water three times a-day, so confidently affirmed by Josephus† and other ancients, and confirmed by prince Radziville and other moderns, who pretend to have been eye-witnesses of it, is all now in the same manner exploded by others of more modern date, and of at least equal candour. The unhealthiness of the air about the lake was affirmed by Josephus and Pliny, especially on the west: the monks that live in the neighbourhood confirm the same, and would have dissuaded Dr Pococke from going to it on that account; and, as he ventured to go and bath in it, and was, two days after, seized with a dizziness, and violent pain in the stomach, which lasted near three weeks, they made no doubt but it was occasioned by it; and he doth not seem to contradict them. As to the water, it is, though clear, so impregnated with salt, that those who dive into it come out covered with a kind of saline matter. There is one remarkable thing relating to this lake, generally agreed on by all travellers and geographers; viz. that it receives the waters of Jordan, a considerable river, the brooks of Jabbok, Kishon, Arnon, and other springs, which flow into it from the adjacent mountains, and yet never overflows, though there is no visible way to be found by which it discharges that great influx. Some naturalists have been greatly embarrassed to find a discharge for these waters, and have therefore been inclined to suspect the lake had a communication with the Mediterranean. But, besides that we know of no gulph to corroborate this supposition, it has been demonstrated by accurate calculations, that evaporation is more than sufficient to carry off the waters brought by the river. It is, in fact, very considerable; and frequently becomes sensible to the eye, by the fogs with which the lake is covered at the rising of the sun, and which are afterwards dispersed by the heat. It is inclosed on the east and west with exceeding high mountains, many of them craggy and dreadful to behold. On the north it has the plains of Jericho; or, if we take in both sides of the Jordan, it has the Great Plain, properly so called, on the south; which is open, and extends beyond the reach of the eye. Josephus gives this lake 580 furlongs in length, from the mouth of the Jordan to the town of Segor, on the opposite end, that is about 22 leagues; and about 150 furlongs,

† *Bel. Jud.* lib. v. cap. 5.

Asphaltites

furlongs, or five leagues, in its largest breadth: but our modern accounts commonly give it 24 leagues in length and 6 or 7 in breadth. On the west side of it is a kind of promontory, where they pretend to show the remains of Lot's metamorphosed wife. Josephus says it was still standing in his time; but when Prince Radziville inquired after it, they told him there was no such salt pillar or statue to be found in all that part. However, they have found means, about a century after him, to recover, as they pretended to assure Mr Maundrell, a block or stump of it, which may in time grow up, with a little art, into its ancient bulk.

It is to be observed here, that the name of *Dead Sea* is not to found in the sacred writings; but hath been given to this lake because no creature will live in it, on account of its excessive saltness, or rather bituminous quality; for the Hebrews rank sulphur, nitre, and bitumen, under the general name of *salt*. However, some late travellers have found cause to suspect the common report of its breeding no living creature; one of them having observed, on the shore, two or three shells of fish like those of an oyster, and which he supposes to have been thrown up by the waves, at two hours distance from the mouth of the Jordan, which he there takes notice of, lest they should be suspected to have been brought into the lake by that way. And Dr Pococke, though he neither saw fish nor shells, tells us, on the authority of a monk, that some sort of fish had been caught in it; and gives us his opinion, that as so many sorts live in salt-water, some kind may be so formed as to live in a bituminous one. Mr Volney, however, affirms, that it contains neither animal nor vegetable life. We see no verdure on its banks, nor a fish to be found within its waters. But he adds, that it is not true that its exhalations are pestiferous, so as to destroy birds flying over it. "It is very common (says he) to see swallows skimming its surface, and dipping for the water necessary to build their nests. The real cause which deprives it of vegetables and animals is the extreme saltness of the water, which is infinitely stronger than that of the sea. The soil around it, equally impregnated with this salt, produces no plants; and the air itself, which becomes loaded with it from evaporation, and which receives also the sulphureous and bituminous vapours, cannot be favourable to vegetation: hence the deadly aspect which reigns around this lake. In other respects, the ground about it, however, is not marshy; and its waters are limpid and incorruptible, as must be the case with a dissolution of salt. The origin of this mineral is easy to be discovered; for on the south-west shore are mines of fossil salt, of which I have brought away several specimens. They are situated in the side of the mountains which extend along that border; and, for time immemorial, have supplied the neighbouring Arabs, and even the city of Jerusalem. We find also on this shore fragments of sulphur and bitumen, which the Arabs convert into a trifling article of commerce; as also hot fountains, and deep crevices, which are discovered at a distance by little pyramids built on the brink of them. We likewise find a sort of stone, which, on rubbing, emits a noxious smell, burns like bitumen, receives a polish like white alabaster, and is used for the paving of courtyards. At intervals, we also meet with unshapen blocks, which prejudiced eyes mistake for mutilated statues, and which pass with ignorant and superstitious pilgrims for monuments of the adventure of Lot's wife; though it is no where said she was metamorphosed into stone like Niobe, but into salt, which must have melted the ensuing winter."

Asphaltite Asphaltum

It is on account of this bitumen that it hath had the name of *Asphaltite Lake*, it being reported to have thrown up great quantities of that drug, which was much in use among the Egyptians, and other nations, for embalming of dead bodies. Josephus assures us, that in his days it rose in lumps as big as an ox without its head, and some even larger. But, whatever it may have formerly done, we are assured by Mr Maundrell and others, that it is now to be found but in small quantities along the shore, though in much greater near the mountains on both sides the lake. But the contrary is since affirmed by two or more late* travellers; the one of whom tells us, that it is observed to float on the surface of the water, and to come on the shore, after windy weather, where the Arabians gather it, and put it to all the uses that common pitch is used for, even in the compositions of some medicines: and another † tells us, he was there informed, that it was raised at certain times from the bottom, in large hemispheres, which, as soon as they touch the surface, and are acted upon by the external air, burst at once, with great noise and smoke, like the *pulvis fulminans* of the chemists, dispersing themselves about in a thousand pieces. From both these judicious authors we may conclude the reason of Mr Maundrell's mistake, both as to the lake's throwing it up only on certain seasons (that reverend gentleman might chance to be there at the wrong time); and likewise as to his not observing it about the shores, seeing the Arabs are there ready to gather it as soon as thrown up; all of them describe it as resembling our black pitch, so as not to be distinguished from it but by its sulphureous smoke and stench when set on fire; and it hath been commonly thought to be the same with that which our druggists sell under the name of *bitumen Judaicum*, or *Jewish pitch*, though we have reason to think that this last is factitious, and that there is now none of the asphaltum brought from Judea.

* *Pococke's Travels*, p. 56.

† *Shaw's Travels*, p. 374.

It hath, moreover, been confounded with a sort of blackish combustible stone thrown on the shore, and called by some *Moses's* stone, which, being held in the flame of a candle, will soon burn, and cast a smoke and intolerable stench; but with this extraordinary property, that though it loses much of its weight and colour, it becoming in a manner white, yet it diminishes nothing of its bulk. But these, Dr Pococke tells us, are found about two or three leagues from the shore. He concludes, however, from it, that a *stratum* of that stone under the lake is probably one part of the matter that feeds the subterraneous fire, and causes the bitumen to boil up out of it.

ASPHALTUM, BITUMEN JUDAICUM, or JEWS PITCH, is a light solid bitumen, of a dusky colour on the outside, and a deep shining black within; of very little taste; and having scarcely any smell, unless heated, when it emits a strong pitchy one. It is found in a soft or liquid state on the surface of the Dead Sea, and by age grows dry and hard. The same kind of bitumen is met with likewise in the earth, in other parts of the world, in China, America, and in some places of Europe, as the Carpathian hills, France, Neufchatel,

&c.

&c. There are feveral kinds of Jews pitch in the fhops: but none of them are the genuine fort, and have little other title to their name, than their being artificially compounded by Jews; and as they are a medley of we know not what ingredients, their medicinal ufe begins to be defervedly laid afide, notwithftanding the difcutient, refolvent, practoral, and other virtues, attributed to this bitumen by the ancients. The true afphaltum was formerly ufed in embalming the bodies of the dead. The thick and folid afphalta are at prefent employed in Egypt, Arabia, and Perfia, as pitch for fhips; as the fluid ones, for burning in lamps, and for varnifhes. Some writers relate, that the walls of Babylon, and the temple of Jerufalem, were cemented with bitumen inftead of mortar. Thus much is certain, that a true natural bitumen, that for inftance, which is found in the diftrict of Neufchatel, proves an excellent cement for walls, pavements, and other purpofes, uncommonly firm, very durable in the air, and not penetrable by water. The watch and clock makers ufe a compofition of afphaltum, fine lamp-black, and oil of fpike or turpentine, for drawing the black figures on dial-plates: this compofition is prepared chiefly by certain perfons at Augfburg and Nuremberg. See the preceding article.

ASPHODELUS, ASPHODEL, or KING'S SPEAR: A genus of the monogynia order, belonging to the hexandria clafs of plants. The calyx is divided into fix parts; and the nectarium confifts of fix valves covering the nectarium.—The

Species are five. 1. The luteus, or common yellow afphodel, hath roots compofed of many thick flefhy fibres, which are yellow, and joined into a head at the top; from whence arife ftrong round fingle ftalks near three feet high, garnifhed on the upper part with yellow ftar-fhaped flowers, which appear in June, and the feeds ripen in autumn. 2. The ramofus, or branching afphodel, hath roots compofed of flefhy fibres, to each of which is faftened an oblong bulb as large as a fmall potatoe; the leaves are long and flexible, having fharp edges; between thefe come out the flower-ftalks, which arife more than three feet high, fending forth many lateral branches. The upper parts of thefe are adorned with many white ftar-fhaped flowers, which grow in long fpikes flowering gradually upward. They come out in the beginning of June, and the feeds ripen in autumn. 3. The ramofus, or unbranched afphodel, hath roots like the fecond, but the leaves are longer and narrower; the ftalks are fingle, never putting out any fide branches. The flowers appear at the fame time with the former, are of a purer white, and grow in longer fpikes. 4. The albus, with keel-fhaped leaves, hath roots compofed of fmaller fibres than the two laft, nor are the knobs at bottom half fo large; the leaves are long, almoft triangular, and hollow like the keel of a boat; the ftalks feldom rife above two feet high, and divide into feveral fpreading branches; thefe are terminated by loofe fpikes of white flowers fmaller than thofe of the former. 5. The ftulofus, or annual branching fpiderwort, hath roots compofed of many yellow flefhy fibres: the leaves are fpread out from the crown of the root, clofe to the ground, in a large clufter; thefe are convex on their under fide, but plain above. The flower-ftalks rife immediately from the root, and grow about two feet high, dividing into three or four branches upward, which are adorned with white ftarry flowers, with purple lines on the outfide. Thefe flower in July and Auguft, and their feeds ripen in October.

Culture. The way to increafe thefe plants is by parting their roots in Auguft, before they fhoot up their frefh green leaves. They may alfo be raifed from feeds fown in Auguft; and the Auguft following the plants produced from thefe may be tranfplanted into beds, and will produce flowers the fecond year. They muft not be planted in fmall borders, among tender flowers; for they will draw away all the nourifhment, and ftarve every thing elfe.

The Lancafhire afphodel is thought to be very noxious to fheep, whenever, through poverty of pafture, they are neceffitated to eat it; although they are faid to improve much in their flefh at firft, they afterwards die with fymptoms of a difeafed liver. This is the plant of which fuch wonderful tales have been told by Pauli, Bartholine, and others, of its foftening the bones of fuch animals as fwallow it; and which they thence called *gramen offifragum*. Horned cattle eat it without any ill effect.

ASPHURELATA, in natural hiftory, are femimetallic foffils, fufible by fire, and not malleable in their pureft ftate, being in their native ftate intimately mixed with fulphur and other adventitious matter, and reduced to what are called *ores*.

Of this feries of foffils, there are only five bodies, each of which makes a diftinct genus; viz. antimony, bifmuth, cobalt, zinc, and quickfilver.

ASPICUETA (Martin de), commonly called the Doctor of Navarre, or *Doctor Navarrus*, was defcended of a noble family, and born the 13th of December 1491, at Varafayn, a fmall city of Navarre, not far from Pampeluna. He entered very young into the monaftery of Regular canons at Roncevaux, where he took the habit which he continued to wear after he left the convent. He ftudied claffical learning, natural and moral philofophy, and divinity, at Alcala, in New-Caftile, adopting chiefly the fyftem of Petrus Lombardus, commonly called the *Mafter of the Sentences*. He applied to the ftudy of the law at Ferrara, and taught it with applaufe at Touloufe and Cahors. After being firft profeffor of canon low at Salamanca for 14 years, he quitted that place to be profeffor of law at Coimbra, with a larger falary. The duties of this office he difcharged for the fpace of 20 years, and then refigned it to retire into his own country, where he took care of his nieces, the daughters of his deceafed brothers. Having made a journey to Rome to plead the caufe of Bartholomeo de Caranza archbifhop of Toledo, who had been accufed of herefy before the tribunal of the inquifition in Spain, and whofe caufe was, by the Pope's order, to be tried in that city, Afpiceuta's writings, which were well known, procured him a moft honourable reception. Pope Pius V. made him affiftant to cardinal Francis Aciat, his vice-penitentiary; and Gregory XIII. never paffed by his door without calling for him, and ftopped fometimes a whole hour to talk with him in the ftreet. His name became fo famous, that even in his lifetime the higheft encomium on a learned man was to call him a *Navarrus*. He was confulted as an oracle. By temperance he prolonged his life to a great length. His œconomy enabled him to give fubsubstantial proofs of his charity. Being very old, he used to ride on a mule through the city, and relieved all the poor he met; to which his mule was so well accustomed, that it stopped of its own accord at the sight of every poor man till its master had relieved him. He refused several honourable posts in church and state, that he might have leisure to correct and improve the works he had already written, and compose others. He died at the age of 94, on the 21st of June 1586. He wrote a vast number of treatises, all which are either on morality or canon law.

ASPIRATE, in grammar, denotes words marked with the spiritus asper. See ASPER.

ASPIRATION, among grammarians, is used to denote the pronouncing a syllable with some vehemence.

ASPLENIUM, CETERACH: A genus of the order of filices, belonging to the cryptogamia class of plants. The parts of fructification are situated in the small sparse line under the disk of the leaves. There are 24 species. Two of these are natives of Britain, and grow upon old walls or moist rocks; one is called *scolopendrium*, or *hart's tongue*: the other is properly *ceterach*, also called *spleenwort*. It has an herbaceous, somewhat mucilaginous, roughish taste: it is recommended as a pectoral, and for promoting urine in nephritic cases. The virtue which it has been most celebrated for is that which it has the least title to, viz. diminishing the spleen.

ASS, in zoology, is ranked as a species of equus, or horse. See EQUUS.

Coronation of the Ass, in antiquity, was a part of the ceremony of the feast of Vesta, wherein the bakers put bread crowns on the heads of these quadrupeds; *Ecce coronatis panis dependet asellis* *. Hence, in an ancient calendar, the ides of June are thus denoted: *Festum est Vestæ. Asinus coronatur!*—This honour, it seems was done the beast, because, by its braying, it had saved Vesta from being ravished by the Lampsacan god. Hence the formula, *Vestæ delicium est asinus*.

* Ovid Fast. vi. 311.

ASSAI, in music, signifies quick; and, according to others, that the motion of the piece be kept in a middle degree of quickness or slowness. As, *Assai allegro, assai presto*. See ALLEGRO and PRESTO.

ASSANCALA, a strong town in Armenia, near the river Arras, in the road between Erzerum and Erivan, and noted for its hot baths. It stands on a high hill; the walls are built in a spiral line all round the rock and strengthened with square towers. The ditches are about two fathoms over, cut out of hard rock. E. Long. 41. 30. N. Lat. 39. 46.

ASSANCHIF, a town of Asia, in Diarbekir, seated on the river Tigris. E. Long. 42. 30. N. Lat. 37. 20.

ASSANS. See ASSENS.

ASSARIUM, in antiquity, denotes a small copper coin, being a part or diminutive of the *as*. The word ασσαριον is used by Suidas indifferently with οβολος and νομισμα, to denote a small piece of money; in which he is followed by Cujacius, who defines ασσαριον by *Minimus æris nummus*. We find mention of the assarion in the gospel of St Matthew, chap. x. verse 29.

ASSARON, or OMER, a measure of capacity, in use among the Hebrews, containing five pints. It the measure of manna which God appointed for every Israelite.

ASSASIN, or ASSASSIN, a person who kills another with the advantage either of an inequality in the weapons, or by means of the situation of the place, or by attacking him at unawares.

The word *assassin* is said by some to have been brought from the Levant, where it took its rise from a certain prince of the family of the *Arsacidæ*; popularly called *Assassins*, living in a castle between Antioch and Damasco, and bringing up a number of young men, ready to pay a blind obedience to his commands; whom he employed in murdering the princes with whom he was at enmity. But according to Mr Volney, the word *Hassassin* (from the root *hass*, "to kill, assassinate, to listen, to surprise,") in the vulgar Arabic signifies "Robbers of the night," persons who *lie in ambush to kill*; and is universally understood in this sense at Cairo and in Syria. Hence it was applied to the *Batenians*, who slew by surprise. See the next article.

There was a certain law of nations, an opinion received in all the republics of Greece and Italy, whereby he that assassinated an usurper of the supreme power was declared a virtuous man. At Rome especially, after the expulsion of the kings, the law was formal and solemn, and instances of it admitted. The commonwealth armed the hand of any citizen, and created him magistrate for that moment.

ASSASSINS, a tribe or clan in Syria, called also *Ismaelians* and *Batanists* or *Batenians*. These people probably owed their origin to the Kirmatians, a famous heretical sect among the Mahometans, who settled in Persia about the year 1090; whence, in process of time, they sent a colony into Syria, where they became possessed of a considerable tract of land among the mountains of Lebanon, extending itself from the neighbourhood of Antioch to Damascus.

The first chief and legislator of this remarkable tribe appears to have been Hassan Sabah, a subtle impostor, who by his artifices made fanatical and implicit slaves of his subjects. Their religion was compounded of that of the Magi, the Jews, the Christians, and the Mahometans: but the capital article of their creed was to believe that the Holy Ghost resided in their chief; that his orders proceeded from God himself, and were real declarations of his divine pleasure. To this monarch the orientals gave the name of *Scheik*: but he is better known in Europe by the name of the *Old Man of the Mountain*. His dignity, instead of being hereditary, was confirmed by election; where merit, that is, a superior multiplicity and enormity of crimes, was the most effectual recommendation to a majority of suffrages.

This chief, from his exalted residence on the summit of mount Lebanon, like a vindictive deity, with the thunderbolt in his hand, sent inevitable death to all quarters of the world; so that from one end of the earth to the other, kalifs, emperors, sultans, kings, princes, Christians, Mahometans, and Jews, every nation and people, execrated and dreaded his sanguinary power, from the strokes of which there was no security. At the least suggestion or whisper that he had threatened the death of any potentate, all immediately doubled their guards, and took every other precaution in their power.

power. It is known that Philip Auguftus king of France, on a premature advice that the Scheik intended to have him affaffinated, inftituted a new body-guard of men diftinguifhed for their activity and courage, called *fergens d'Armes*, with brafs clubs bows and arrows; and he himfelf never appeared without a club, fortified either with iron or gold. Moft fovereigns paid fecretly a penfion to the Scheik, however fcandalous and derogatory it might be to the luftre of majefty, for the fafety of their perfons. The Knights Templars alone dared to defy his fecret machinations and open force. Indeed they were a permanent difperfed body, not to be cut off by maffacres or affaffinations.

This barbarous prince was furnifhed with refources unknown to all other monarchs even to the moft abfolute defpotic tyrant. His fubjects would proftrate themfeves at the foot of his throne, requefting to die by his hand or order, as a favour by which they were fure of paffing in paradife. On them if danger made any impreffion, it was an emulation to prefs forward; and if taken in any enterprife, they went to the place of execution with a magnanimity unknown to others. Henry count of Champaigne, who married Ifabella daughter of Amaury king of Jerufalem, paffing over part of the territory of the Affaffins in his way to Syria, and talking highly of his power, their chief came to meet him, "Are your fubjects (faid the old man of the mountain) as ready in their fubmiffion as mine?" and, without ftaying for an anfwer, made a fign with his hand, when ten young men in white, who were ftanding on an adjacent tower, inftantly threw themfelves down. On another occafion, Sultan Malek-Shah fummoning the Scheik to fubmit himfelf to his government, and threatening him with the power of his arms, fhould he hefitate to comply; the latter, very compofedly turning himfelf towards his guards, faid to one of them, "Draw your dagger and plunge it into your breaft;" and to another, "Throw yourfelf headlong from yonder rock." His orders were no fooner uttered than they were joyfully obeyed: and all the anfwer he deigned to give the fultan's envoy was, "Away to thy mafter, and let him know I have many thoufand fubjects of the fame difpofition." Men fo ready to deftroy themfelves were equally alert and refolute in being the minifters of death to others. At the command of their fovereign, they made no difficulty of ftabbing any prince, even on his throne; and being well verfed in the different dialects, they conformed to the drefs and even the external religion of the country, that they might with lefs difficulty ftrike the fatal blow required by their chief. With the Saracens they were Mahometans; with the Franks, Chriftians; in one place they joined with the Mamaluks; in another, with the ecclefiaftics or religious; and under this difguife feized the firft opportunity of executing their fanguinary commiffion. Of this we meet with an inftance in the hiftory of Saladin, while he was befieging Manbedge, the celebrated Hieropolis of antiquity. Being one day, with a few attendants, and they at fome diftance, reconnoitring the place for the better difpofition of the attack, a man rufhed on him with a dagger in his hand, and wounded him in the head; but the fultan, as he was endeavouring to repeat his ftroke, wrefted the dagger from him, and, after receiving feveral wounds, laid him dead at his feet. Before the fultan had well recovered himfelf, a fecond encountered him to finifh the treachery of the former; but he met with the fame fate: he was fucceeded with equal fury by a third, who alfo fell by the hand of that magnanimous prince whom he was fent to affaffinate. And it was obferved, that thefe wretches dealt about their fruitlefs blows as they lay in the agonies of death. With fuch rapidity was this tranfacted, that it was over before Saladin's guards could come to his affiftance. He retired to his tent, and in great perturbation throwing himfelf on his fopha, ordered his fervants to take a ftrict view of his houfehold, and to cafhier all fufpected perfons; at the fame time afking with great earneftnefs, "Of whom have I deferved fuch treacherous ufage?" But it afterwards appeared, that thefe villains had been fent by the old man of the mountain; of whom the vizir Kamfchlegin had purchafed the murder of Saladin, to free himfelf from fo great a warrior whom he could not meet in the field. To animate them in their frantic obedience, the Scheik, before their departure on fuch attempts, ufed to give them a fmall foretafte of fome of the delights which he affured them would be their recompenfe in paradife. Delicious foporific drinks were given them; and while they lay afleep, they were carried into beautiful gardens, where very allurement invited their fenfes to the moft exquifite gratifications. From thefe feats of voluptuoufnefs, inflamed with liquor and enthufiaftic views of perpetual enjoyments, they fallied forth to perform affaffinations of the blackeft dye.

This people once had, or atleaft they feigned to have, an intention of embracing the Chriftian religion. They reigned a long time in Perfia and on Mount Lebanon. Hulaku, a khan of the Mogul Tartars, in the year 655 of the Hegira, or 1254 of the Chriftian æra, entered their country and difpoffeffed them of feveral places; but it was not till the year 1272 that they were totally conquered. This atchievement was owing to the conduct and intrepidity of the Epyptian forces fent againft them by the fultan Bibaris. It has, however, been thought that the Drufes, who ftill refide among the eminences of Mount Lebanon, and whofe religion and cuftoms are fo little known, are a remnant of thofe barbarians.

ASSAULT, in law, is an attempt or offer to beat another, without touching him: as if one lifts up his cane or his fift in a threatening manner at another; or ftrikes at him, but miffes him; this is an affault, *infultus*, which Finch defcribes to be "an unlawuful fetting upon one's perfon." This alfo is an inchoate violence, amounting confiderably higher than bare threats; and therefore, though no actual fuffering is proved, yet the party injured may have redrefs by action of *trefpafs vi et armis*, wherein he fhall recover damages as a compenfation for the injury.

ASSAULT, in the military art, a furious effort made to carry a fortified poft, camp, or fortrefs, wherein the affailants do not fcreen themfelves by any works: while the affault continues, the batteries ceafe, for fear of killing their own men.—The *enfans perdus* march firft to the affault. See *ENFANS Perdus*.

ASSAY, ESSAY, or SAY, in metallurgy, the proof or trial of the goodnefs, purity, value, &c. of metals and metalline fubftances. See ESSAY.

In ancient statutes this is called *touch;* and those who had the care of it, *Keepers of the touch.*—Under Henry VI. divers cities were appointed to have touch for wrought silver-plate, 2 Hen. VI. c. 14.—By this, one might imagine they had no better method of assaying than the simple one by the touch-stone; but the case is far otherwise. In the time of King Henry II. the bishop of Salisbury, then treasurer, considering that though the money paid into the king's exchequer for his crown-rents did answer *numero et pondere*, it might nevertheless be mixed with copper or brass: wherefore a constitution was made, called the *trial by combustion*; which differs little or nothing from the present method of assaying silver. See a description of it in the Black Book in the Exchequer, written by Gervase of Tilbury, c. xxi. This trial is also there called *essaium*, and the officer who made it is named *fusor*. The method still in use of assaying gold and silver was first established by an act of the English parliament 1354.

Assaying, *ars docimastica*, in its extent, comprehends particular manners of examining every ore, or mixed metal, according to its nature, with the best-adapted fluxes; so as to discover, not only what metals, and what proportions of metal, are contained in ores; but likewise how much sulphur, vitriol, alum, arsenic, smelt, &c. may be obtained from every one respectively. See Blow-pipe, Metallurgy, and Mineralogy.

Assaying is more particularly used by moneyers and goldsmiths, for the making a proof or trial by the cuppel, or test, of the fineness or purity of the gold and silver to be used in the coining of money, and manufacture of plate, &c. or that have been already used therein.

There are two kinds of assaying; the one before metals are melted, in order to bring them to their proper fineness; the other after they are struck, to see that the species be standard. For the first assay, the assayers use to make 14 or 15 grains of gold, and half a dram of silver, if it be for money; and 18 grains of the one, and a dram of the other, if for other occasions. As to the second assay, it is made of one of the pieces of money already coined, which they cut in four parts. The quantity of gold for an assay among us is six grains: In France, nearly the same; and in Germany, about three times as much.

The proper spelling of that word, however, is essay; under which article, therefore, the reader will find the subject more particularly treated.

Assay-Balance, or *Essay-Balance*, the flat pieces of glass often placed under the scales of an assay-balance, seem, by their power of electricity, capable of attracting, and thereby making the lighter scale preponderate, where the whole matter weighed is so very small. See *Essay-Bala*nce.

The electricity of a flat surface of about three inches square has been known to hold down one scale, when there were about 200 grains weight in the other. See Balance.

Assay-Master, or *Essay-Master*, an officer under certain corporations entrusted with the care of making true touch, or assay, of the gold and silver brought to him; and giving a just report of the goodness or badness thereof. Such is the assay-master of the mint in the Tower, called also *assayer of the king*.

The assay-master of the goldsmiths company is a sort of assistant-warden, called also a *touch-warden*, appointed to survey, assay, and mark all the silver-work, &c. committed to him. There are also assay-masters appointed by statute at York, Exeter, Bristol, Chester, Norwich, Newcastle, and Birmingham, for assaying wrought plate. The assay-master is to retain eight grains of every pound Troy of silver brought to him; four whereof are to be put in the pix, or box of deal, to be re-assayed the next year, and the other four to be allowed him for his waste and spillings.

Note, The number of pennyweights set down in the assay-master's report, is to be accounted as per pound, or so much in every pound of 12 ounces Troy. For every 20 penny-weight, or ounce Troy, the silver is found by the assay to be worse than standard, or sterling, sixpence is to be deducted; because every ounce will cost so much to reduce it to standard goodness, or to change it for sterling.

In gold, for every carat it is set down to be worse than standard, you must account that in the ounce Troy it is worse by so many times 3 s. 8 d.; and for every grain it is set down worse, you must account it worse by so many times 11 d. in the ounce Troy; and for every half grain 5¼d.: for so much it will cost to make it of standard goodness, &c.

ASSELYN (John), a famous Dutch painter, was born in Holland, and became the disciple of Isaiah Vandevelde, the battle-painter. He distinguished himself in history-paintings, battles, landscapes, animals, and particularly horses. He travelled into France and Italy; and was so pleased with the manner of Bambochio, that he always followed it. He painted many pictures at Lyons, where he married the daughter of a merchant of Antwerp, and returned with her to Holland. Here he first discovered to his countrymen a fresh and clear manner of painting landscapes, like Claude Lorraine; upon which all the painters imitated his style, and reformed the dark brown they had hitherto followed. Asselyn's pictures were so much admired at Amsterdam, that they sold there at a high price. He died in that city in 1660. Twenty-four pieces of landscapes and ruins, which he painted in Italy, have been engraved by Perelle.

ASSEMBLAGE, the uniting or joining of things together; or the things themselves so united or joined. It is also used, in a more general sense, for a collection of various things so disposed and diversified, that the whole produces some agreeable effect.

ASSEMBLY, the meeting of several persons, in the same place, upon the same design.

Assembly, in the beau monde, an appointed meeting of fashionable persons of both sexes, for the sake of play, dancing, gallantry, conversation, &c.

Assembly, in the military art, the second beating of a drum before a march; at which the soldiers strike their tents, roll them up, and stand to arms.

Assemblies of the clergy are called *convocations, synods, councils*. The annual meeting of the church of Scotland is called a *General Assembly:* In this assembly his Majesty is represented by his Commissioner, who dissolves one meeting, and calls another, in the name of the *King*, while the Moderator does the same in the name of the *Lord Jesus Christ*.

Assemblies of the Roman people were called *comitia*.

Under the Gothic governments, the supreme legislative power was lodged in an assembly of the states of the kingdom, held annually for the like purposes as the British parliament. Some feeble remains of this usage still subsist in the annual assemblies of the states of Languedoc, Bretagne, and a few other provinces of France; but these are no more than shadows of the ancient assemblies. It is only in Great Britain, Sweden, and Poland, that such assemblies retain their ancient powers and privileges.

ASSENS, a sea-port town of Denmark, situated upon the Little Belt, a strait of the Baltic, which separates the isle of Funen from the continent. It is the common passage from the duchy of Sleswick to Copenhagen. E. Long. 10. 30. N. Lat. 55. 15.

ASSENT, in a general sense, implies an agreement to something proposed or affirmed by another.

Royal Assent, the approbation given by the king to a bill in parliament, after which it becomes a law.

ASSER (John), or Asserius Menevensis, that is, *Asser of St David's*, bishop of Shirburn in the reign of Alfred the Great. He was born in Pembrokeshire, in South Wales; and educated in the monastery of St David's by the archbishop Asserius, who, according to Leland, was his kinsman. In this monastery he became a monk, and by his assiduous application soon acquired universal fame as a person of profound learning and great abilities. Alfred, the munificent patron of genius, about the year 880, sent for him to court. The king was then at Dean in Wiltshire. He was so charmed with Asser, that he made him his preceptor and companion. As a reward for his services, he appointed him abbot of two or three different monasteries; and at last promoted him to the episcopal see of Shirburn, where he died and was buried in the year 910. He was, says Pits, a man of a happy genius, wonderful modesty, extensive learning, and great integrity of life. He is said to have been principally instrumental in persuading the king to restore the university of Oxford to its pristine dignity and lustre.—He wrote, *De vita et rebus gestis Alfredi*, &c. Lond. 1574, published by Archbishop Parker, in the old Saxon character, at the end of *Walsinghami hist.*——Francf. 1602. fol. Oxf. 1722, 8vo. Many other works are ascribed to this author by Gale, Bale, and Pits, but all doubtful.

ASSERIA. See Asisia.

ASSERTION, in the language of the schools, a proposition advanced by the assertor, who avows the truth of it, and is ready to defend it.

ASSESSOR, an inferior officer of justice, appointed chiefly to assist the ordinary judge with his opinion and advice.

Assessor is also one who assesses or settles taxes and other public dues.

ASSETS, in law, signifies goods enough to discharge that burden which is cast upon the executor or heir, in satisfying the debts and legacies of the testator or ancestor. Assets are real or personal. Where a man hath lands in fee simple, and dies seised thereof, the lands which come to his heir are assets real; and where he dies possessed of any personal estate, the goods which come to the executors are assets personal. Assets are also divided into *assets per descent*, and *assets inter maines*. Assets by descent is where a person is bound in an obligation, and dies seised of lands which descend to the heir, the land shall be assets, and the heir shall be charged as far as the land to him descended will extend. *Assets inter maines* is when a man indebted makes executors, and leaves them sufficient to pay his debts and legacies; or where some commodity or profit ariseth to them in right of the testator, which are called *assets in their hands*.

ASSEVERATION, a positive and vehement affirmation of something.

ASSHETON (William), doctor of divinity, and rector of Beckenham, in Kent, was born in the year 1641, and was educated at Brazen-nose college, Oxford. After entering into orders, he became chaplain to the Duke of Ormond, and was admitted doctor of divinity in 1673. Soon after, he was nominated to a prebend in the church of York, presented to the living of St Antholin, London, and to the rectory of Beckenham in Kent. He was the first projector of the scheme for providing for clergymens widows, and others, by a jointure payable out of the mercers company. He wrote several pieces against the Papists and Dissenters, and some devotional tracts. He died at Beckenham in September 1711, in the 70th year of his age.

ASSIDEANS, or Chassidæans, (from the Hebrew *chasidim*, "merciful, pious"); those Jews who resorted to Mattathias to fight for the law of God and the liberties of their country. They were men of great valour and zeal, having voluntarily devoted themselves to a more strict observation of the law than other men. For, after the return of the Jews from the Babylonish captivity, there were two sorts of men in their church; those who contented themselves with that obedience only which was prescribed by the law of Moses, and who were called *Zadikim*, i. e. the *righteous*; and those who, over and above the law, superadded the constitutions and traditions of the elders, and other rigorous observances: these latter were called *Chasidim*, i. e. the *pious*. From the former sprung the Samaritans, Sadducees, and Caraites; from the latter, the Pharisees and the Essenes.

ASSIDENT signs, in medicine, are symptoms which usually attend a disease but not always; hence differing from *pathognomic* signs, which are inseparable from the disease: *e. gr.* In the pleurisy, a pungent pain in the side; in an acute fever, difficulty of breathing, &c. collectively taken, are pathognomic signs; but that the pain extends to the hypochondrium or clavicle, or that the patient lies with more ease on one side than on the other, are *assident* signs.

ASSIDUUS, or Adsiduus, among the Romans, denoted a rich or wealthy person. The word in this sense is derived from *as assis*, q. d. a monied man. Hence we meet with *assiduous* sureties, *assidui fidejussores*; answering to what the French now call city sureties or securities, *cautions bourgeois*.

When Servius Tullius divided the Roman people into five classes, according as they were assessed or taxed to the public, the richer sort who contributed asses were denominated *assidui*; and as these were the chief people of business who attended all the public concerns, those who were diligent in attendances came to be denominated *assidui*.

ASSIENTO, a Spanish word signifying a *farm*, in commerce, is used for a bargain between the king of Spain

Spain and other powers, for importing negroes into the Spanish dominions in America, and particularly to Buenos Ayres. The first assiento was made with the French Guinea-company; and, by the treaty of Utrecht, transferred to the English, who were to furnish 4800 negroes annually.

ASSIGN, in common law, a person to whom a thing is assigned or made over.

ASSIGNATION, an appointment to meet. The word is generally understood of love-meetings.

ASSIGNEE, in law, a person appointed by another to do an act, transact some business, or enjoy a particular commodity.

ASSIGNING, in a general sense, implies the making over the right of one person to another. In a particular sense, it signifies the pointing out of something; as, an error, false judgment, or waste.

ASSIGNMENT, the transferring the interest one has in a lease, or other thing, to another person.

ASSIMILATION, in physics, is that motion by which bodies convert other bodies related to them, or at least such as are prepared to be converted, into their own substance and nature. Thus, flame multiplies itself upon oily bodies, and generates new flame; air upon water, and produces new air; and all the parts, as well similar as organical, in vegetables and animals, first attract with some election or choice, nearly the same common or not very different juices for aliment, and afterwards assimilate or convert them to their own nature.

ASSISE, in old English law-books, is defined to be an assembly of knights, and other substantial men, together with a justice, in a certain place, and at a certain time: but the word, in its present acceptation, implies a court, place or time, when and where the writs and processes, whether civil or criminal, are decided by judge and jury.

All the counties of England are divided into six circuits; and two judges are assigned by the king's commission, who hold their assises twice a-year in every county (except London and Middlesex, where courts of *nisi prius* are holden in and after every term, before the chief or other judge of the several superior courts; and except the four northern counties, where the assises are taken only once a year) to try by a jury of the respective counties the truth of such matters of fact as are then under dispute in the courts of Westminster-hall. These judges of assise came into use in the room of the ancient justices in eyre, *justiciarii in itinere:* who were regularly established, if not first appointed, by the parliament of Northampton, A. D. 1176, 22 Hen. II. with a delegated power from the king's great court or *aula regia*, being looked upon as members thereof: and they afterwards made their circuit round the kingdom once in seven years for the purpose of trying causes. They were afterwards directed by *magna charta*, c. 12. to be sent into every county once a-year to take or try certain actions then called *recognitions* or *assises;* the most difficult of which they are directed to adjorn into the court of common pleas to be there determined. The itinerant justices were sometimes mere justices of assise, or of dower, or of gaol-delivery, and the like; and they had sometimes a more general commission, to determine all manner of causes, *justiciarii ad omnia placita:* but the present justices of assise and *nisi prius* are more immediately derived from the statute Westm. 2, 13 Edw. I. c. 30. explained by several other acts, particularly the statute 14 Edw. III. c. 16. and must be two of the king's justices of the one bench or the other, or the chief baron of the exchequer, or the king's serjeants sworn. They usually make their circuits in the respective vacations after Hilary and Trinity terms; assises being allowed to be taken in the holy time of Lent by consent of the bishops at the king's request, as expressed in statute Westm. 1. 3 Edw. I. c. 51. And it was also usual, during the times of Popery, for the prelates to grant annual licenses to the justices of assise to administer oaths in holy times: for oaths being of a sacred nature, the logic of those deluded ages concluded that they must be of ecclesiastical cognizance. The prudent jealousy of our ancestors ordained that no man of law should be judge of assise in his own county: and a similar prohibition is found in the civil law, which has carried this principle so far, that it is equivalent to the crime of sacrilege, for a man to be governor of the province in which he was born, or has any civil connection.

The judges upon their circuits now sit by virtue of five several authorities. 1. The commission of the *peace*, in every county of the circuits; and all justices of the peace of the county are bound to be present at the assises; and sheriffs are also to give their attendance on the judges, or they shall be fined. 2. A commission of *oyer* and *terminer*, directed to them and many other gentlemen of the county, by which they are empowered to try treasons, felonies, &c. and this is the largest commission they have. 3. A commission of general *gaol-delivery*, directed to the judges and the clerk of assise associate, which gives them power to try every prisoner in the gaol committed for any offence whatsoever, but none but prisoners in the gaol; so that one way or other they rid the gaol of all the prisoners in it. 4. A commission of *assise*, directed to the judges and clerk of assise, to take assises; that is, to take the verdict of a peculiar species of jury called *an assise*, and summoned for the trial of *landed* disputes. The other authority is, 5. That of *nisi prius*, which is a consequence of the commission of *assise*, being annexed to the office of those justices by the statute of Westm. 2. 13 Edw. I. c. 30. And it empowers them to try all questions of fact issuing out of the courts of Westminster, that are then ripe for trial by jury. The original of the name is this: all causes commenced in the courts of Westminister-hall are by the course of the courts appointed to be there tried, on a day fixed in some Easter or Michaelmas term, by a jury returned from the county wherein the cause of action arises; but with this proviso, *nisi prius justiciarii ad assisas capiendas venerint; unless before* the day prefixed the judges of assise come into the county in question. This they are sure to do in the vacations preceding each Easter and Michaelmas term, and there dispose of the cause; which saves much expence and trouble, both to the parties, the jury, and the witnesses.

The word *assise* (from the French *assis*, seated, settled, or established, and formed of the Latin verb *assideo*, I sit by) is used in several different senses. It is sometimes taken for the sittings of a court; sometimes for its regulations or ordinances, especially those that fix the

the ſtandard of weights and meaſures; and ſometimes it ſignifies a jury, either becauſe juries conſiſted of a fixed determined number, or becauſe they continued ſitting till they pronounced their verdict. In Scots law, an aſſiſe or jury conſiſts of fifteen ſworn men *(juratores)*, picked out by the court from a greater number, not exceeding 45, who have been ſummoned for that purpoſe by the ſheriff, and given in liſt to the defender, at ſerving him with a copy of his libel.

ASSISIO, an epiſcopal town of Italy, in the duchy of Spoleto, built on the ſide of a very high mountain. The cathedral of St Francis is very magnificent, and compoſed of three churches one above another. E. Long. 13. 35. N. Lat. 43. 4.

ASSITHMENT, a wiregeld, or compenſation, by a pecuniary mulct; from the prepoſition *ad*, and the Sax. *ſithe, vicè: quod vicè ſupplicii ad expiandum delictum ſolvitur.*

ASSOCIATION, the act of aſſociating, or conſtituting a ſociety, or partnerſhip, in order to carry on ſome ſcheme or affair with more advantage.—The word is Latin, *aſſociatio;* and compounded of *ad*, to, and *ſocio*, to join.

Association of Ideas, is where two or more ideas conſtantly and immediately follow or ſucceed one another in the mind, ſo that one ſhall almoſt infallibly produce the other whether there be any natural relation between them or not. See Metaphysics.

Where there is a real affinity or connection in ideas, it is the excellency of the mind to be able to collect, compare, and range them in order, in its inquiries: but where there is none, nor any cauſe to be aſſigned for their accompanying each other, but what is owing to mere accident or habit; this unnatural aſſociation becomes a great imperfection, and is, generally ſpeaking, a main cauſe of error, or wrong deductions in reaſoning. Thus the idea of goblins and ſprights, it has been obſerved, has really no more affinity with darkneſs than with light; and yet let a fooliſh maid inculcate theſe ideas often on the mind of a child, and raiſe them there together, it is poſſible he ſhall never be able to ſeparate them again ſo long as he lives, but darkneſs ſhall ever bring with it thoſe frightful ideas. With regard to this inſtance, however, it muſt at the ſame time be obſerved, that the connection alluded to appears far from being either unnatural or abſurd. See the article Apparition.

Such wrong combinations of ideas, Mr Locke ſhows, are a great cauſe of the irreconcileable oppoſition between the different ſects of philoſophy and religion: for we cannot imagine, that all who hold tenets different from, and ſometimes even contradictory to, one another, ſhould wilfully and knowingly impoſe upon themſelves, and refuſe truth offered by plain reaſon: but ſome looſe and independent ideas are by education, cuſtom, and the conſtant din of their party, ſo coupled in their minds that they always appear there together: theſe they can no more ſeparate in their thoughts, than if they were but one idea, and they operate as if they were ſo. This gives ſenſe to jargon, demonſtration to abſurdities, conſiſtency to nonſenſe, and is the foundation of the greateſt, and almoſt of all, the errors in the world.

Aſſociation forms a principal part of Dr Hartley's mechanical theory of the mind. He diſtinguiſhes it into ſynchronous and ſucceſſive; and aſcribes our ſimple and complex ideas to the influence of this principle or habit. Particular ſenſations reſult from previous vibrations conveyed through the nerves to the medullary ſubſtance of the brain; and theſe are ſo intimately aſſociated together, that any one of them, when impreſſed alone, ſhall be able to excite in the mind the ideas of all the reſt. Thus we derive the ideas of natural bodies from the aſſociation of the ſeveral ſenſible qualities with the names that expreſs them, and with each other. The ſight of part of a large building ſuggeſts the idea of the reſt inſtantaneouſly, by a ſynchronous aſſociation of the parts; and the ſound of the words, which begin a familiar ſentence, brings to remembrance the remaining parts, in order, by ſucceſſive aſſociation. Dr Hartley maintains, that ſimple ideas run into complex ones by aſſociation; and apprehends, that by purſuing and perfecting this doctrine, we may ſome time or other be enabled to analyſe thoſe complex ideas that are commonly called the *ideas of reflection*, or *intellectual ideas*, into their ſeveral component parts, i. e. into the ſimple idea of ſenſation of which they conſiſt; and that this doctrine may be of conſiderable uſe in the art of logic, and in explaining the various phenomena of the human mind.

Association of Parliament. In the reign of king William III. the Britiſh parliament entered into a ſolemn aſſociation to defend his majeſty's perſon and government againſt all plots and conſpiracies; and all perſons bearing offices civil or military, were enjoined to ſubſcribe the aſſociation to ſtand by king William, on pain of forfeitures and penalties, &c. by ſtat. 7 and 8 W. III. c. 27.

ASSOILZIE, in law, to abſolve or free.

ASSONANCE, in rhetoric and poetry, a term uſed where the words of a phraſe or a verſe have the ſame ſound or termination, and yet make no proper rhyme. Theſe are uſually accounted vicious in Engliſh; though the Romans ſometimes uſed them with elegancy: as, *Militem comparavit, exercitum ordinavit, aciem luſtravit.*

ASSONANT rhymes, is a term particularly applied to a kind of verſes among the Spaniards, where a reſemblance of ſound ſerves inſtead of a natural rhyme. Thus, *ligera, cubierta, tierra, meſa*, may anſwer each other in a kind of *aſſonant* rhyme, having each an *e* in the penult ſyllable, and *a* in the laſt.

ASSUAN. See Syene.

ASSUMPSIT, in the law of England, a voluntary or verbal promiſe, whereby a perſon aſſumes, or takes upon him to perform or pay any thing to another.

A promiſe is in the nature of a verbal covenant, and wants nothing but the ſolemnity of writing and ſealing to make it abſolutely the ſame. If therefore it be to do any explicit act, it is an expreſs contract, as much as any covenant: and the breach of it is an equal injury. The remedy indeed is not exactly the ſame: ſince, inſtead of an action of covenant, there only lies an action upon the caſe, for what is called an *aſſumpſit* or undertaking of the defendant; the failure of performing which is the wrong or injury done to the plaintiff, the damages whereof a jury are to eſtimate and ſettle. As, if a builder promiſes, undertakes, or aſſumes to Caius, that he will build and cover his houſe within a time limited, and fails to do it; Caius has an action on the caſe againſt the builder for this breach

Assumpsit. breach of his express promise, undertaking, or assumpsit; and shall recover a pecuniary satisfaction for the injury sustained by such delay. So also in the case of a debt by simple contract, if the debtor promises to pay and does not, this breach of promise intitles the creditor to his action on the case, instead of being driven to an action of debt. Thus likewise a promissory note, or note of hand not under seal to pay money at a day certain, is an express assumpsit; and the payee at common law, or by custom and act of parliament the indorsee, may recover the value of the note in damages, if it remains unpaid. Some agreements indeed, though never so expresly made, are deemed of so important a nature, that they ought not to rest in verbal promise only which cannot be proved but by the memory (which sometimes will induce the perjury) of witnesses. To prevent which, the statute of frauds and perjuries, 29 Car. II. c. 3. enacts, that in the five following cases no verbal promise shall be sufficient to ground an action upon, but at the least some note or memorandum of it shall be made in writing, and signed by the party to be charged therewith: 1. When an executor or administrator promises to answer damages out of his own estate. 2. Where a man undertakes to answer for the debt, default, or miscarriage, of another. 3. Where any agreement is made upon consideration of marriage. 4. Where any contract or sale is made of lands, tenements, or hereditaments, or any interest therein. 5. And lastly, where there is any agreement that is not to be performed within a year from the making thereof. In all these cases, a mere verbal assumpsit is void.

From these express contracts the transition is easy to those that are only implied by law. Which are such as reason and justice dictate, and which therefore the law presumes that every man has contracted to perform; and, upon this presumption, makes him answerable to such persons as suffer by his non-performance.

Thus, 1. If I employ a person to transact any business for me, or perform any work, the law implies that I undertook, or assumed, to pay him so much as his labour deserved: and if I neglect to make him amends, he has a remedy for this injury by bringing his action on the case upon this implied assumpsit; wherein he is at liberty to suggest that I promised to pay him so much as he reasonably deserved, and then to aver that his trouble was really worth such a particular sum, which the defendant has omitted to pay. But this valuation of his trouble is submitted to the determination of a jury; who will assess such a sum in damages as they think he really merited. This is called an *assumpsit* on a *quantum meruit*.

2. There is also an implied assumpsit on a *quantum valebat*, which is very similar to the former; being only where one takes up goods or wares of a tradesman, without expresly agreeing for the price. There the law concludes, that both parties did intentionally agree that the real value of the goods should be paid; and an action on the case may be brought accordingly, if the vendee refuses to pay that value.

3. A third species of implied assumpsit is when one has had and received money belonging to another without any valuable consideration given on the receiver's part; for the law construes this to be money had and received for the use of the owner only; and implies that the person so receiving, promised and undertook to account for it to the true proprietor. And, if he unjustly detains it, an action on the case lies against him for the breach of such implied promise and undertaking; and he will be made to repair the owner in damages, equivalent to what he has detained in such violation of his promise. This is a very extensive and beneficial remedy, applicable to almost every case where the defendant has received money which *ex æquo et bono* he ought to refund. It lies for money paid by mistake, or on a consideration which happens to fail, or through imposition, extortion, or oppression, or where undue advantage is taken of the plaintiff's situation. Assumpsit.

4. Where a person has laid out and expended his own money for the use of another at his request, the law implies a promise of repayment, and an action will lie on this assumpsit.

5. Likewise, fifthly, upon a stated account between two merchants, or other persons, the law implies that he against whom the balance appears has engaged to pay it to the other; though there be not any actual promise. And from this implication it is frequent for actions on the case to be brought, declaring that the plaintiff and defendant had settled their accounts together, *insimul computassent*, (which gives name to this species of assumpsit); and that the defendant engaged to pay the plaintiff the balance, but has since neglected to do it. But if no account has been made up, then the legal remedy is by bringing a writ of *account de computo*; commanding the defendant to render a just account to the plaintiff, or shew the court good cause to the contrary. In this action, if the plaintiff succeeds, there are two judgments; the first is, that the defendant do account *(quod computet)* before auditors appointed by the court; and when such account is finished, then the second judgment is, that he do pay the plaintiff so much as he is found in arrear.

6. The last class of contracts, implied by reason and construction of law, arises upon this supposition, that every one who undertakes any office, employment, trust, or duty, contracts with those who employ or entrust him, to perform it with integrity, diligence, and skill: and if by his want of either of those qualities any injury accrues to individuals, they have therefore their remedy in damages, by a special action on the case. A few instances will fully illustrate this matter. If an officer of the public is guilty of neglect of duty, or a palpable breach of it, of non-feasance or of mis-feasance; as, if the sheriff does not execute a writ sent to him, or if he wilfully makes a false return thereof; in both these cases, the party aggrieved shall have an action *on the case*, for damages to be assessed by a jury. If a sheriff or goaler suffers a prisoner who is taken upon mesne process (that is, during the pendency of a suit) to escape, he is liable to an action *on the case*. But if after judgment, a goaler or a sheriff permits a debtor to escape, who is charged in execution for a certain sum; the debt immediately becomes his own, and he is compellable by action of *debt*, being for a sum liquidated and ascertained, to satisfy the creditor in his whole demand. An advocate or attorney that betray the cause of their client, or, being retained, neglect to appear at the trial, by which the cause miscarries, are liable to an action on the case, for a reparation to their injured client. There is also in law always an

implied

implied contract with a common innkeeper, to secure his guest's goods in his inn; with a common carrier or barge-master, to be answerable for the goods he carries; with a common farrier, that he shoes a horse well, without laming him; with a common taylor, or other workman, that he performs his business in a workmanlike manner; in which if they fail, an action on the case lies to recover damages for such breach of their general undertaking. Also if an innkeeper, or other victualler, hangs out a sign and opens his house for travellers, it is an implied engagement to entertain all persons who travel that way; and upon this universal *assumpsit* an action on the case will lie against him for damages, if he without good reason refuses to admit a traveller. In contracts likewise for sales, if the seller doth upon the sale warrant it to be good, the law annexes a tacit contract to this warranty, that if it be not so, he shall make compensation to the buyer: else it is an injury to good faith, for which an action on the case will lie to recover damages.

ASSUMPTION, a festival in the Romish church, in honour of the miraculous ascent of the Virgin Mary into heaven: the Greek church, who also observe this festival, celebrate it on the 15th of August with great ceremony.

Assumption, in logic, is the minor or second proposition in a categorical syllogism.

Assumption is also used for a consequence drawn from the propositions whereof an argument is composed.

Assumption, an island of North-America, in the gulph of St Lawrence, at the mouth of the great river of the same name. It is covered with trees. W. Long. 60. 40. N. Lat. 49. 30.

Assumption, a large and handsome town of Proper Paraguay, on the river of the same name in South America. It is a bishop's see, is well peopled, and seated in a country fruitful in corn and fruits, whose trees are always green. There is likewise a quantity of pasture, and the air is temperate and salutary. W. Long. 60. 40. S. Lat. 34. 10.

ASSUMPTIVE arms, in heraldry, are such as a person has a right to assume, with the approbation of his sovereign, and of the heralds: thus, if a person, who has no right by blood, and has no coat of arms, shall captivate, in any lawful war, any gentleman, nobleman, or prince, he is, in that case, entitled to bear the shield of that prisoner, and enjoy it to him and his heirs for ever.

ASSURANCE, or Insurance, in commerce. See Insurance.

ASSUROR, a merchant, or other person, who makes out a policy of assurance, and thereby insures a ship, house, or the like.

ASSUS, or Assos (anc. geog.), a town of Troas (though by others supposed to be of Mysia), and the same with Apollonia (Pliny); but different from the Apollonia on the river Rhyndacus. Ptolemy places it on the sea-coast, but Strabo more inland; if he does not mean the head of an inland bay, as appears from Diodorus Siculus. It was the country of Cleanthes the stoic philosopher, who succeeded Zeno. St Luke and others of St Paul's companions in his voyage (Acts xx. 13. 14), went by sea from Troas to Assos: but St Paul went by land thither, and meeting them at Assos, they all went together to Mytelene. It is still called *Assos*. E. Long. 27. 30. Lat. 38. 30.

ASSYRIA, an ancient kingdom of Asia, concerning the extent, commencement, and duration of which, historians differ greatly in their accounts. Several ancient writers, in particular Ctesias and Diodorus Siculus, have affirmed, that the Assyrian monarchy, under Ninus and Semiramis, comprehended the greater part of the known world. Had this been the case, it is not likely that Homer and Herodotus would have omitted a fact so remarkable. The sacred records intimate, that none of the ancient states or kingdoms were of considerable extent; for neither Chederlaomer, nor any of the neighbouring princes, were tributary or subject to Assyria; and we find nothing of the greatness or power of this kingdom in the history of the Judges and succeeding kings of Israel, though the latter kingdom was oppressed and enslaved by many different powers in that period. It is highly probable, therefore, that Assyria was originally of small extent. According to Ptolemy, it was bounded on the north by Armenia Major; on the west by the Tigris; on the south by Susiana; and on the east by Media.

It is probable, that the origin and revolutions of the Assyrian monarchy were as follows.—The founder of it was Ashur, the second son of Shem, who went out of Shinar, either by the appointment of Nimrod, or to elude the fury of a tyrant; conducted a large body of adventurers into Assyria, and laid the foundation of Nineveh (Gen. x. 11.) These events happened not long after Nimrod had established the Chaldæan monarchy, and fixed his residence at Babylon. The Persian historians suppose that the kings of Persia of the first dynasty were the same with the kings of Assyria, of whom Zohah, or Nimrod, was the founder of Babel (Herbelot Orient. Bibl. v. *Bagdad*). It does not, however, appear, that Nimrod reigned in Assyria. The kingdoms of Babylon and Assyria, were originally distinct and separate (Micah v. 6.), and in this state they remained until Ninus conquered Babylon, and made it tributary to the Assyrian empire. Ninus, the successor of Ashur (Gen. x. 11. Diod. Sic. L. 1.), seized on Chaldæa, after the death of Nimrod, and united the kingdoms of Assyria and Babylon. This great prince is said to have subdued Asia, Persia, Media, Egypt, &c. If he did so, the effects of his conquests were of no duration; for, in the days of Abraham, we do not find that any of the neighbouring kingdoms were subject to Assyria. He was succeeded by Semiramis; a princess of an heroic mind; bold, enterprising, fortunate; but of whom many fabulous things have been recorded. It appears, however, that there were two princesses of the same name, who flourished at very different periods. One of them was the consort of Ninus; and the other lived five generations before Nitocris queen of Nebuchadnezzar (Euseb. Chron. p. 58. Herod. L. i. c. 184.) This fact has not been attended to by many writers.

Playfair's Chronology.

Whether there was an uninterrupted series of kings from Ninus to Sardanapalus, or not, is still a question. Some suspicion has arisen, that the list which Ctesias has given of the Assyrian kings is not genuine; for many names in it are of Persian, Egyptian, and Grecian extraction.

Nothing memorable has been recorded concerning the successors of Ninus and Semiramis. Of that effeminate race of princes it is barely said, that they ascended the throne, lived in indolence, and died in their palace at Nineveh. Diodorus (L. ii.) relates, that, in the reign of Teutames, the Assyrians, solicited by Priam their vassal, sent to the Trojans a supply of 20,000 foot and 200 chariots, under the command of Memnon, son of Tithonus president of Persia: But the truth of this relation is rendered doubtful by the accounts of other writers.

Sardanapalus was the last of the ancient Assyrian kings. Contemning his indolent and voluptuous course of life, Arbaces, governor of Media, withdrew his allegiance, and rose up in rebellion against him. He was encouraged in this revolt by the advice and assistance of Belesis, a Chaldean priest, who engaged the Babylonians to follow the example of the Medes. These powerful provinces, aided by the Persians and other allies, who despised the effeminacy, or dreaded the tyranny of their Assyrian lords, attacked the empire on all sides. Their most vigorous efforts were, in the beginning, unsuccessful. Firm and determined, however, in their opposition, they at length prevailed, defeated the Assyrian army, besieged Sardanapalus in his capital, which they demolished, and became masters of the empire, B. C. 821.

After the death of Sardanapalus, the Assyrian empire was divided into three kingdoms, viz. the Median, Assyrian, and Babylonian. Arbaces retained the supreme power and authority, and fixed his residence at Ecbatana in Media. He nominated governors in Assyria and Babylon, who were honoured with the title of *kings*, while they remained subject and tributary to the Median monarchs. Belesis received the government of Babylon as the reward of his services; and Phul was entrusted with that of Assyria. The Assyrian governor gradually enlarged the boundaries of his kingdom, and was succeeded by Tiglath-pilefer, Salmanasar, and Sennacherib, who asserted and maintained their independency. After the death of Assar-haddon, the brother and successor of Senacherib, the kingdom of Assyria was split, and annexed to the kingdoms of Media and Babylon. Several tributary princes afterwards reigned in Nineveh; but no particular account of them is found in the annals of ancient nations. We hear no more of the kings of Assyria, but of those of Babylon. Cyaxares king of Media, assisted Nebuchadnezzar king of Babylon, in the siege of Nineveh, which they took and destroyed, B. C. 606. The Chaldean or Babylonish kingdom was transferred to the Medes, after the reign of Nabonadius, son of Evilmerodach, and grandson of Nebuchadnezzar. He is styled Belshazzar in the sacred records, and was conquered by Cyrus, B. C. 538.

ASSYTHMENT. See ASSITHMENT.

ASTA, an inland town of Liguria, a colony, (Ptolemy); on the river Tanarus: Now *Asti*. E. Long. 8. 15. Lat. 44. 40.

Asta Regia, a town of Bætica, (Pliny); situated at that mouth of the Bætis which was choaked up with mud, to the north of Cadiz; 16 miles distant from the port of Cadiz, (Antonine). Its ruins show its former greatness. Its name is Phœnician, denoting a *frith* or arm of the sea, on which it stood. It is said to be the same with XERA; which see.

ASTABAT, a town of Armenia, in Asia, situated near the river Aras, 12 miles south of Nakshivan. The land about it is excellent, and produces very good wine. There is a root peculiar to this country, called *ronas*; which runs in the ground like liquorice, and serves for dyeing red. It is very much used all over the Indies, and for it they have a great trade. E. Long. 46. 30. N. Lat. 39. 0.

ASTANDA, in antiquity, a royal courier or messenger, the same with ANGARUS.—King Darius of Persia is said by Plutarch, in his book on the fortune of Alexander, to have formerly been an *astanda*.

ASTAROTH, or ASHTAROTH, in antiquity, a goddess of the Sidonians.—The word is Syriac, and signifies *sheep*, especially when their udders are turgid with milk. From the fecundity of these animals, which in Syria continue to breed a long time, they formed the notion of a deity, whom they called *Astaroth*, or *Astarte*. See ASTARTE.

ASTAROTH, (anc. geog.) the royal residence of Og king of Bashan; whether the same with Astaroth Carnaim, is matter of doubt: if one and the same, it follows from Eusebius's account, that it lay in Bashan, and to the east of Jordan, because in the confines of Arabia.

ASTARTE, in Pagan mythology (the singular of Astaroth), a Phœnician goddess, called in Scripture the *queen of heaven*, and the *goddess of the Sidonians.*—Solomon, in complement to one of his queens, erected an alter to her. In the reign of Ahab, Jezebel caused her worship to be performed with much pomp and ceremony: she had 400 priests; the women were employed in weaving hangings or tabernacles for her; and Jeremiah observes, that "the children gathered the "wood, the fathers kindled the fire, and the women "kneaded the dough, to make cakes for the queen of "heaven."

ASTARTE, (anc. geog.) a city on the other side Jordan; one of the names of Rabbath Ammon, in Arabia Petræa, (Stephanus).

ASTEISM, in rhetoric, a genteel irony, or handsome way of deriding another. Such, *e. gr.* is that of Virgil:

Qui Bavium non odit, amet tua carmina, Mævi, &c.

Diomed places the characteristic of this figure, or species of irony, in that it is not gross and rustic, but ingenious and polite.

ASTELL (Mary), the great ornament of her sex and country, was the daughter of —— Astell, an opulent merchant of Newcastle upon Tyne, where she was born about the year 1668. She was educated in a manner suitable to her station; and, amongst other accomplishments, was mistress of the French, and had some knowledge of the Latin tongue. Her uncle, a clergyman, observing in her some marks of a promising genius, took her under his tuition, and taught her mathematics, logic, and philosophy. She left the place of her nativity when she was but 20 years of age, and spent the remaining part of her life at London and at Chelsea. Here she pursued her studies with great assiduity, made great proficiency in the abovementioned sciences, and acquired a more complete knowledge of many classic authors. Among these Seneca, Epictetus, Hierocles, Antoninus, Tully, Plato, and Xenophon, were her principal favorites.

Her life was spent in writing for the advancement of learning, religion, and virtue; and in the practice of those religious duties which she so zealously and pathetically recommended to others, and in which perhaps no one was ever more sincere and devout. Her sentiments of piety, charity, humility, and other Christian graces, were uncommonly refined and sublime; and religion sat gracefully upon her, unattended with any forbidding airs of sourness or of gloom. Her mind was generally calm and serene; and her conversation was innocently facetious, and highly entertaining. She would say, "The good Christian only hath reason, and he always ought, to be cheerful;" and, "That dejected looks and melancholy airs were very unseemly in a Christian." But these subjects she hath treated at large in some of her excellent writings.

She was remarkably abstemious; and seemed to enjoy an uninterrupted state of health till a few years before her death; when, having one of her breasts cut off, it so much impaired her constitution, that she did not long survive it. This painful operation she underwent without discovering the least timidity, or so much as uttering a groan; and showed the same resolution and resignation during her whole illness. When she was confined to her bed by a gradual decay, and the time of her dissolution drew near, she ordered her shroud and coffin to be made and brought to her bedside; and there to remain in her view, as a constant memento of her approaching fate, and to keep her mind fixed on proper contemplation. She died in the year 1731, in the 63d year of her age, and was buried at Chelsea. She wrote, 1. A Serious Proposal to the Ladies. 2. An Essay in Defence of the Female Sex. 3. Letters concerning the Love of God. 4. Reflections upon Marriage. 5. Moderation truly stated. 6. The Christian Religion, as professed by a Daughter of the Church of England; and some other works.

ASTER, STARWORT: A genus of the polygamia superflua order, belonging to the syngenesia class of plants; and in the natural method ranking under the 49th order, *Compositæ discoides*. The receptacle is naked; the papus is simple; the rays of the corolla are 10; and the calyx is imbricated. There are above 30 species. All of them may be raised from seed sown either in autumn or spring: but the greatest part of them being perennial plants, and increasing greatly at the roots, are generally propagated by parting their roots early in the spring, and they will grow in almost any soil or situation; and the larger sorts increase so fast, that, if not prevented, they will in a little time run over a large space of ground. They grow best in the shade: the lower kinds do not run so much at the root, but should be taken up and transplanted every other year; which will make them produce much fairer flowers. Some few sorts, which are natives of warm climates, will require artificial heat to raise them, if not to preserve them.

ASTER, or *Stella Marina*, in zoology. See ASTERIAS.

ASTERABAD, a province in the north-east part of Persia, having Tabristan on the west, part of the Caspian Sea and part of Jorjan on the north, Korasan on the west, and Koumas on the south. It is a mountainous country, except near the banks of the rivers that almost surround it, where it is pleasant, and fruitful, producing grapes of a prodigious size. In other parts the soil is sandy and barren. Asterabad is the chief town, which gives name to a gulph in the Persian Sea, at the bottom of which it stands. E. Long. 54. 35. N. Lat. 36. 50.

ASTERIA, in zoology, a name by which some authors have called the *falco palumbarius*, or *goshawk*. See FALCO.

ASTERIA is also the name of a gem, usually called the *cat's eye*, or *oculus cati*. It is a very singular and very beautiful stone, and somewhat approaches to the nature of the opal, in having a bright included colour, which seems to be lodged deep in the body of the stone, and shifts about, as it is moved, in various directions: but it differs from the opal in all other particulars, especially in its want of the great variety of colours seen in that gem, and in its superior hardness. It is usually found between the size of a pea and the breadth of a sixpence; is almost always of a semicircular form, broad and flat at the bottom, and rounded and convex at the top; and is naturally smooth and polished. It has only two colours, a pale brown and a white; the brown seeming the ground, and the white playing about in it, as the fire colour in the opal. It is considerably hard, and will take a fine polish, but is usually worn with its native shape and smoothness. It is found in the East and West Indies, and in Europe. The island of Borneo affords some very fine ones, but they are usually small; they are very common in the sands of rivers in New Spain; and in Bohemia they are not unfrequently found immersed in the same masses of jasper with the opal.

ASTERIA is also the name of an extraneous fossil, called in English the *star-stone*. These fossils are small, short, angular, or sulcated columns, between one and two inches long, and seldom above a third of an inch in diameter: composed of several regular joints; when separated, each resembles a radiated star. They are, not without reason, supposed to be a part of some sea-fish petrified, probably the asterias or sea-star. The asteria is also called *astrites*, *astroites*, and *asteriscus*. They may be reduced to two kinds: those whose whole bodies make the form of a star; and those which in the whole are irregular, but are adorned as it were with constellations in the parts. Dr Lister, for distinction's sake, only gives the name *asteria* to the former sort, distinguishing the latter by the appellation of *astroites*; other naturalists generally use the two indiscriminately. The asteria spoken of by the ancients appears to be of this latter kind. The quality of moving in vinegar, as if animated, is scarce perceivable in the astroites, but is signal in the asteria. The former must be broken in small pieces before it will move; but the latter will move, not only in a whole joint, but in two or three knit together. The curious frequently meet with these stones in many parts of England: at Cleydan in Oxfordshire they are found rather larger than common, but of a softer substance; for, on being left a small space of time in a strong acid, they may easily be separated at the joints in small plates.

ASTERIAS, STAR-FISH, or SEA-STAR, in zoology, a genus of insects of the order of vermes mollusca. It has a depressed body, covered with a coriaceous coat; is composed of five or more segments, running out from a central part, and furnished with numerous tentacula; and has the mouth in the centre.—The conformation of the mouth is this: The under part of each lobe runs towards a point with the rest at the centre of the body; and these several productions of the rays make a sort of lips, the ends of each of which are armed with a number of sharp teeth, which serve to take and convey the food into the body. From this mouth there goes a separate canal to all or many of the rays, which runs through their whole length, and becomes gradually narrower as it approaches the extremity. The tentacula resembles the horns of snails, but serve the animal to walk with. They are capable of being contracted or shortened: and it is only at the creature's moving that they are seen of their full length; at other times, no part of them is seen but the extremity of each, which is formed like a sort of button, being somewhat larger than the rest of the horn.

Most of the species of asterias are found in the British seas. 1. The glacialis, with five rays, depressed, broad at the base, yellow, and having a round striated operculum on the back, is the most common; it feeds on oysters, and is very destructive to the beds. 2. The clathatra, or cancellated sea-star, with five short thick rays, hirsute beneath, cancellated above, is found with the former, but more rare. 3. The oculata, with five smooth rays, dotted or punctured, is of a fine purple colour, and is found about Anglesea. 4. The hispida, with five rays, broad, angulated at top, and rough with short bristles, is of a brown colour, and likewise found about Anglesea. 5. The placenta, with five very broad and membranaceous rays, extremely thin and flat, is found about Weymouth. 6. The spherulata, with a pentagonal indented body; a small globular bead between the base of each ray; the rays slender, jointed, taper, and hirsute on their sides; found off Anglesea. 7. The caput medusæ, or aborescent sea-star, with five rays issuing from an angular body; the rays dividing into innumerable branches, growing slender as they recede from the base. These the animal, in swimming, spreads like a net to their full length; and when he perceives any prey within them, draws them in again, thus catching it with all the dexterity of a fisherman. It is an inhabitant of every sea, and is called by some the *Magellanic star-fish* and *basket-fish*. When it extends its rays fully, it forms a circle of three feet diameter. The fragments of these rays furnish the fossile entrochi. If we drown this animal in brandy or spirits of wine, and keep the rays flat and expanded in the execution, it is easy to extract, by means of a pair of forceps, the stomach of the animal whole and entire through the mouth. The decacnemos, has ten slender rays, with numbers of long beards on the sides: the body is small, and surrounded beneath with ten small filiform rays. It inhabits the western coasts of Scotland.—There are several other species mentioned by authors; some of them of 10, 12, 13, or even 14 rays.

Aristotle and Pliny called this genus αστηρ, and *stella marina*, from their resemblance to the pictured form of the stars of heaven; and they asserted that they were so exceedingly hot, as instantly to consume whatsoever they touched.

The fossil world has been greatly enriched by the fragments and remains of the several pieces of star-fish which have been converted into stones. See ASTERIA.

ASTERIAS, the ancient name of the bittern. See ARDEA.

ASTERISK, a mark in form of a star (*), placed over a word or sentence, to refer the reader to the margin, or elsewhere, for a quotation, explanation, or the like.

ASTERIUS, or ASTURIUS, a Roman consul, in 449. We have under his name, *A Conference on the Old and New Testament*, in Latin verse: in which each strophe contains, in the first verse, an historical fact in the Old Testament; and in the second, an application of that fact to some point in the New.

ASTERN, a sea-phrase, used to signify any thing at some distance behind the ship, being the opposite of AHEAD, which signifies the space before her. See AHEAD.

ASTEROPODIUM, a kind of extraneous fossil, of the same substance with the asteriæ or star-stones, to which they serve as a base. See ASTERIA and STAR-STONE.

ASTHMA, See the *Index* subjoined to MEDICINE.

ASTI, a city of Montferrat in Italy, seated on the Tanaro, and capital of the county of the same name. It is a bishop's see, and well fortified with strong walls and deep ditches; and is divided into the city, borough, citadel, and castle. There are a great many churches and convents, as well as other handsome buildings; and its territory is well watered, abounding with groves, pleasant hills, and spacious fields. It was taken by the French in 1745, and retaken by the king of Sardinia in 1746. E. Long. 8. 15. N. Lat. 54. 50.

ASTIGI, (anc. geog.), a colony, and conventus juridicus, of Bætica, surnamed *Augusta Firma*, situated on the Singulus, which falls into the Bætis; called also *Colonia Astigitana* (Pliny): Now *Ecya*, midway between Seville and Corduba. W. Long. 5°. Lat. 37. 20.

ASTOMI, in anthropology, a people feigned without mouths. Pliny speaks of a nation of Astomi in India, who lived only by the smell or effluvia of bodies taken in by the nose.

ASTORGA, a very ancient city of Spain, in the kingdom of Leon, with a bishop's see, is seated on the river Tuerta, and well fortified both by art and nature. It stands in a most agreeable plain, about 150 miles north-west of Madrid. There are excellent trouts in the river. W. Long. 6. 20. N. Lat. 42. 20.

ASTRACAN, a province of Russia, and the most easterly part of Europe; bounded on the north by Bulgaria, and Baskiria; on the south, by the Caspian Sea; on the west, by the Volga, which divides it from the Nagayan Tartars and Don Cossacks; and on the east, by the great ridge of mountains which part it from Great Tartary. The province extends from the 46th to the 52d degree of latitude. The summer is long, and intensely hot: the winter continues about three months so severe, that the Volga is frozen hard enough to bear loaded sledges. The soil is rich and fertile; but the Tartars who inhabit it are strangers to agriculture. On the western and southern sides of the Volga are heaths of a prodigious extent, sandy, desert, and uncultivated: these, however, produce vast quantities of fine transparent salt in pits, where the sun bakes and incrustates it to the thickness of an inch on the surface of

Astracan the water. There are pits in the neighbourhood of Aſtracan which yield this excellent ſalt in ſuch abundance, that any perſon may carry it off, paying at the rate of one farthing a pooſt, which is equal to forty pounds. The metropolis Aſtracan, is ſituated within the boundaries of Aſia, on the iſland called *Dolgoi*, about 60 Engliſh miles above the place where the Volga diſembogues itſelf into the Caſpian Sea. The city derives its name from Hadgee Tarken, a Tartar, by whom it was founded. It was conquered by Iwan Baſilowitz, recovered by the Tartars in the year 1668, and retaken by the Czar, who employed for this purpoſe a great number of flat-bottomed veſſels, in which he tranſported his forces down the Volga from Caſan.

The city of Aſtracan is about two miles and a half in circumference, ſurrounded by a brick-wall, which is now in a ruinous condition: but if we comprehend the ſuburbs, the circuit will be near five miles. The number of inhabitants amounts to 70,000, including Armenians and Tartars, as well as a few Perſians and Indians. The garriſon conſiſts of ſix regiments of the beſt Ruſſian troops, who, when this place was alarmed from the ſide of Perſia, had in the adjacent plain erected a great number of ſmall batteries to ſcour the fields, and obſtruct the approach of the enemy. The houſes of Aſtracan are built of wood, and generally mean and inconvenient. The higher parts of the city command a proſpect of the Volga, which is here about three miles in breadth, and exhibits a noble appearance. The marſhy lands on the banks of it render the place very ſickly in the ſummer: the earth being impregnated with ſalt is extremely fertile, and produces abundance of fruit, the immoderate uſe of which is attended with epidemical diſtempers. Sickneſs is likewiſe the conſequence of thoſe annual changes in the atmoſphere produced by the floods in ſpring and autumn. All round the city of Aſtracan, at the diſtance of two miles, are ſeen a vaſt number of gardens, orchards, and vineyards, producing all ſorts of herbs and roots. The grapes are counted ſo delicious, that they are preſerved in ſand, and tranſported to court by land-carriage at a prodigious expence: yet the wine of Aſtracan is very indifferent. The ſummer being generally dry, the inhabitants water their gardens by means of large wheels worked by wind or horſes, which raiſe the water to the higheſt part of the garden, from whence it runs in trenches to refreſh the roots of every ſingle tree and plant. The neighbouring country produces hares and partridges, plenty of quails in ſummmer, with wild and water fowl of all ſorts in abundance.

About ten miles below Aſtracan is a ſmall iſland called *Boſmaiſe*, on which are built large ſtorehouſes for the ſalt, which is made about twelve miles to the eaſtward, and, being brought hither in boats, is conveyed up the Volga, in order to ſupply the country as far as Moſcow and Twere. The quantity of ſalt annually dug for theſe purpoſes amounts to ſome millions of pounds, the excluſive property of which is claimed by the crown, and yields a conſiderable revenue; for the ſoldiers and bulk of the people live almoſt entirely on bread and ſalt. The neighbourhood of theſe ſalt-works is of great advantage to the fiſheries, which extend from hence to the Caſpian Sea, and reach to the ſouth-eaſt as far as Yack, and even 100 miles above Zaritzen. The principal fiſh here caught are ſturgeon and belluga. Theſe being ſalted, are put on board of veſſels, and ſent away in the ſpring, for the uſe of the whole empire, even as far as Peterſburgh: but as fiſh may be kept freſh as long as it is frozen, the winter is no ſooner ſet in than they tranſport great quantities of it by land through all the provinces of Ruſſia. Of the roes of the fiſh called *belluga*, which are white, tranſparent, and of an agreeable flavour, the fiſhers here prepare the caviare, which is in ſo much eſteem all over Europe. Theſe fiſheries were firſt eſtabliſhed by one Tikon Demedoff, a carrier, who ſettled in this place about 60 years ago, his whole wealth conſiſting of two horſes. By dint of ſkill and induſtry, he ſoon grew the richeſt merchant in this country: but his ſucceſs became ſo alluring to the crown, that of late years it hath engroſſed ſome of the fiſheries as well as the ſalt-works. Aſtracan.

From the latter end of July to the beginning of October, the country about Aſtracan is frequently infeſted with myriads of locuſts, which darken the air in their progreſſion from the northward to the ſouthward; and, wherever they fall, conſume the whole verdure of the earth. Theſe inſects can even live for ſome time under water; for when the wind blows acroſs the Volga, vaſt numbers of them fall in cluſters and are rolled aſhore; and their wings are no ſooner dry, than they riſe and take flight again.

Heretofore the inhabitants of Aſtracan traded to Khuva and Bokhara; but at preſent theſe branches are loſt, and their commerce is limited to Perſia and the dominions of Ruſſia. Even the trade of Perſia is much diminiſhed by the troubles of that country: nevertheleſs, the commerce of Aſtracan is ſtill conſiderable. Some years ago the city maintained about 40 veſſels, from 100 to 200 tons burden, for the Caſpian traffic. Some of theſe belong to the government, and are commanded by a commodore, under the direction of the admiralty. This office is generally well ſtocked with naval ſtores, which are ſold occaſionally to the merchants. The trading ſhips convey proviſions to the frontier towns of Terkie and Kiſlar, ſituated on the Caſpian Sea; and tranſport merchandize to ſeveral parts of Perſia. The merchants of Aſtracan export to Perſia, chiefly on account of the Armenians, red leather, linens, woollen cloths, and other European manufactures. In return, they import the commodities of Perſia, particularly thoſe manufactured at Caſan; ſuch as ſilk ſaſhes intermixed with gold, for the uſe of the Poles; wrought ſilks and ſtuffs mixed with cotton; rice, cotton; rhubarb, and a ſmall quantity of other drugs; but the chief commodity is raw ſilk. The government has engroſſed the article of rhubarb, the greater part of which is brought into Ruſſia by the Tartars of Yakutſki, bordering on the eaſtern Tartars belonging to China. They travel through Siberia to Samura, thence to Caſan, and laſtly to Moſcow. The revenue of Aſtracan is computed at 150,000 rubles, or 33,000 pounds, ariſing chiefly from ſalt and fiſh. The city is ruled by a governor, under the check of a chancery. He is nevertheleſs arbitrary enough, and exerciſes oppreſſion with impunity. The officers of the admiralty and cuſtom-houſe having

very

very small salaries, are open to corruption, and extremety rapacious. At christening-feasts which are attended with great intemperance, the guests drink a kind of cherry-brandy out of large goblets; and every person invited throws a present of money into the bed of the mother, who sits up with great formality to be saluted by the company.

The Indians have a Pagan temple at Astracan, in which they pay their adoration, and make offerings of fruit to a very ugly deformed idol. The priests of this pagod use incense, beads, cups, and prostrations. The Tartars, on the contrary, hold idol-worship in the utmost abomination.

ASTRÆA, in astronomy, a name which some give to the sign Virgo, by others called *Erigone*, and sometimes *Isis*. The poets feign that justice quitted heaven to reside on earth, in the golden age; but growing weary of the iniquities of mankind, she left the earth, and returned to heaven, where she commenced a constellation of stars, and from her orb still looks down on the ways of men.

ASTRAGAL, in architecture, a little round moulding, which in the orders surround the top of the shaft or body of the column. It is also called the *talon* and *tondino*; it is used at the bottoms as well as tops of columns, and on other occasions: it properly represents a ring, on whatever part of a column it is placed; and the original idea of it was that of a circle of iron put round the trunk of a tree, used to support an edifice to prevent its splitting. See Plate XXXVI. fig. 2. The astragal is often cut into beads and berries, and is used in the ornamented entablatures to separate the several faces of the architrave.

Astragal, in gunnery, a round moulding encompassing a cannon, about half a foot from its mouth.

ASTRAGALOMANCY, a species of divination performed by throwing small pieces, with marks corresponding to the letters of the alphabet; the accidental disposition of which formed the answer required. This kind of divination was practised in a temple of Hercules, in Achaia. The word is derived from ἀςραγαλος, and μαντεια, *divination*.

ASTRAGALLUS, Milk-vetch, or Liquorice-vetch: A genus of the decandria order, belonging to the diadelphia class of plants: and in the natural method ranking under the 32d order, *Papilionaceæ*. The pod is gibbous and billocular. Of this genus there are 39 species. The common sort grows wild upon dry uncultivated places, and is recommended by Mr Anderson to be cultivated as proper food for cattle (See Agriculture, nº 60, 61.). The other species deserving notice is the tragagantha, a thorny bush growing in Crete, Asia, and Greece, which yields the gum tragracanth. This is of so strong a body, that a dram of it, will give a pint of water the consistence of a syrup, which a whole ounce of gum Arabic is scarce sufficient to do. Hence its use for forming torches, and the like purposes, in preference to the other gums.

Astragalus, in anatomy. See there nº 65.

ASTRANTIA, Masterwort: A genus of the digynia order, belonging to the pentandria class of plants; and in the natural method ranking under the 45th order, *Umbellatæ*. The involucrum is lanceolated, open, equal, and coloured. The species are two, the major and minor, both natives of the Alps, and possessing no remarkable properties.

ASTRICTION, in law. See Thirlage.

Astriction, among physicians, denotes the operation of astringent medicines.

ASTRINGENTS, in the materia medica, substances distinguished by a rough austere taste, and changing solutions of iron, especially those made in the vitriolic acid, into a dark purple or black colour; such are galls, tormentil root, bistort root, balaustines, terra Japonica, acacia, &c. See Materia Medica.

ASTROGNOSIA, the science of the fixed stars, or the knowledge of their names, constellations, magnitudes, &c. See Astronomy.

ASTROITES, or Star-Stone, in natural history. See the articles Asteria and Star-Stone; and Plate LVI.

ASTROLABE, the name of a stereographic projection of the sphere, either upon the plane of the equator, the eye being supposed to be in the pole of the world; or upon the plane of the meridian, when the eye is supposed in the point of the intersection of the equinoxial and horizon.

Astrolabe is also the name of an instrument formerly used for taking the altitude of the sun or stars at sea.

Astrolabe, among the ancients, was the same as our armillary sphere.

ASTROLOGY, a conjectural science, which teaches to judge of the effects and influences of the stars, and to foretel future events by the situation and different aspects of the heavenly bodies.

This science has been divided into two branches, *natural* and *judiciary*. To the former belongs the predicting of natural effects; as the changes of weather, winds, storms, hurricanes, thunder, floods, earthquakes, &c. This art properly belongs to natural philosophy; and is only to be deduced *a posteriori*, from phenomena and observations. Judiciary or judicial astrology, is that which pretends to foretel moral events, i. e. such as have a dependence on the free will and agency of man; as if they were directed by the stars. This art, which owed its origin to the practices of knavery on credulity, is now universally exploded by the intelligent part of mankind.

The professors of this kind of astrology maintain, "That the heavens are one great volume or book, wherein God has written the history of the world; and in which every man may read his own fortune, and the transactions of his time. The art, say they, had its rise from the same hands as astronomy itself: while the ancient Assyrians, whose serene unclouded sky favoured their celestial observations, were intent on tracing the paths and periods of the heavenly bodies, they discovered a constant settled relation of analogy between them and things below; and hence were led to conclude these to be the Parcæ, the Destinies, so much talked of, which preside at our births, and dispose of our future fate.

"The laws therefore of this relation being ascertained by a series of observations, and the share each planet has therein; by knowing the precise time of any person's nativity, they were enabled, from their knowledge in astronomy, to erect a scheme or horoscope of the situation of the planets at that point of time; and hence, Astrology Astronomy

hence, by considering their degrees of power and influence, and how each was either strengthened or tempered by some other, to compute what must be the result thereof."

Thus the astrologers.—But the chief province now remaining to the modern professors, is the making of kalendars or almanacks.

Judicial astrology is commonly said to have been invented in Chaldea, and thence transmitted to the Egyptians, Greeks, and Romans; though some will have it of Egyptian origin, and ascribe the invention to Cham. But it is to the Arabs that we owe it. At Rome, the people were so infatuated with it, that the astrologers, or, as they were then called, the *mathematicians*, maintained their ground in spite of all the edicts of the emperors to expel them out of the city. See GENETHLIACI.

Add, that the Bramins, who introduced and practised this art among the Indians, have hereby made themselves the arbiters of good and evil hours, which gives them great authority: they are consulted as oracles; and they have taken care never to sell their answers but at good rates.

The same superstition has prevailed in more modern ages and nations. The French historians remark, that in the time of queen Catharine de Medicis, astrology was in so much vogue, that the most inconsiderable thing was not to be done without consulting the stars. And in the reigns of king Henry III. and IV. of France, the predictions of astrologers were the common theme of the court conversation. This predominant humour in that court was well rallied by Barclay, in his *Argenis*, lib. ii. on occasion of an astrologer, who had undertaken to instruct king Henry in the event of a war then threatened by the faction of the Guises.

Astronium || Astronomy

ASTRONIUM, in botany: A genus of the pentandria order, belonging to the diœcia class of plants. The male calyx consists of five leaves, and the corolla is quinquepetalous: Of the female the calyx and corolla are the same as in the male; the styli are three, and the seed is single. There is but one species, the graveolens, a native of Jamaica.

ASTRONOMICAL, something relating to ASTRONOMY.

ASTRONOMICAL Calendar, an instrument engraved on copper plates, printed on paper, and pasted on a board, with a brass slider carrying a hair: it shows by inspection the sun's meridian altitude, right ascension, declination, rising, setting, amplitude, &c. to a greater degree of exactness than the common globes.

ASTRONOMICAL Sector, a very useful mathematical instrument, made by the late ingenious Mr Graham; a description of which is given in the course of the following article.

A S T R O N O M Y,

IS a knowledge of the heavenly bodies, with regard to their magnitudes, motions, distances, &c. whether real or apparent; and of the natural causes on which their phenomena depend.

History of Astronomy.

The antiquity of this science may be gathered from what was spoken by the Deity at the time of creating the celestial luminaries, "Let them be for signs and seasons," &c. whence it is thought probable that the human race never existed without some knowledge of astronomy among them. Indeed, besides the motives of mere curiosity, which of themselves may be supposed to have excited people to a contemplation of the glorious celestial canopy, as far as that was possible, it is easily to be seen that some parts of the science answer such essential purposes to mankind, that they could not possibly be dispensed with.

1 Astronomy supposed to be understood by Adam and the Antediluvians.

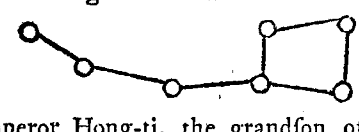
By some of the Jewish rabbins, Adam, in his state of innocence, is supposed to have been endowed with a knowledge of the nature, influence and uses of the heavenly bodies; and Josephus ascribes to Seth and his posterity an extensive knowledge of astronomy. But whatever may be in this, the long lives of the Antediluvians certainly afforded such an excellent opportunity for observing the celestial bodies, that we cannot but suppose the science of astronomy to have been considerably advanced before the flood. Josephus says, that longevity was bestowed upon them for the very purpose of improving the sciences of geometry and astronomy. The latter could not be learned in less that 600 years: "for that period (says he) is the *grand year*." By which it is supposed he meant the period wherein the sun and moon came again into the same situation as they were in the beginning thereof, with regard to the nodes, apogee of the moon, &c. "This period (says Cassini), whereof we find no intimation in any monument of any other nation, is the finest period that ever was invented: for it brings out the solar year more exactly than that of Hipparchus and Ptolemy; and the lunar month within about one second of what is determined by modern astronomers. If the Antediluvians had such a period of 600 years, they must have known the motions of the sun and moon more exactly than their descendants knew them some ages after the flood."

2 Astronomical knowledge of the Chinese.

On the building of the tower of Babel, Noah is supposed to have retired with his children born after the flood, to the north-eastern part of Asia, where his descendants peopled the vast empire of China. "This (says Dr Long) may perhaps account for the Chinese having so early cultivated the study of astronomy; their being so well settled in an admirable police, and continuing so many hundred years as they did in the worship of the true God." The vanity of that people indeed has prompted them to pretend a knowledge of astronomy almost as early as the flood itself. Some of the Jesuit missionaries have found traditional accounts among the Chinese, of their having been taught this science by their first emperor Fo-hi, supposed to be Noah; and Kempfer informs us, that this personage discovered the motions of the heavens, divided time into years and months, and invented the twelve signs into which they divide the zodiac, which they distinguish by the following

3 Their names for the ſigns of the zodiac.

following names. 1. The mouſe. 2. The ox or cow. 3. The tiger. 4. The hare. 5. The dragon. 6. The ſerpent. 7. The horſe. 8. The ſheep. 9. The monkey. 10. The cock or hen. 11. The dog; and, 12. The boar. They divide the heavens into 28 conſtellations, four of which are aſſigned to each of the ſeven planets; ſo that the year always begins with the ſame planet; and their conſtellations anſwer to the 28 manſions of the moon uſed by the Arabian aſtronomers. Theſe conſtellations in the Chineſe books of aſtronomy, are not marked by the figures of animals, as was in uſe among the Greeks, and from them derived to the other European nations, but by connecting the ſtars by ſtraight lines: and Dr Long informs us, that in a Chineſe book in thin 4to, ſhown him by Lord Pembroke, the ſtars were repreſented by ſmall circles joined by lines; ſo that the great bear would be marked thus,



To the emperor Hong-ti, the grandſon of Noah, they attribute the diſcovery of the pole-ſtar, the invention of the mariner's compaſs, of a period of 60 years, and ſome kind of ſphere. This extraordinary antiquity, however, is with good reaſon ſuſpected, as is likewiſe their knowledge in the calculation of eclipſes; of which Du Halde aſſures us, that 36 are recorded by Confucius himſelf, who lived 551 years before Chriſt; and P. Trigault, who went to China in 1619, and read more than 100 volumes of their annals, ſays, "It is certain that the Chineſe began to make aſtronomical obſervations ſoon after the flood; that they have obſerved a great number of eclipſes, in which they have noted down the hour, day, month, and year, when they happened, but neither the duration nor the quantity; and that theſe eclipſes have been made uſe of for regulating their chronology."

"But out of this abundance (ſays Dr Long), it is much to be regretted, that ſo very few of their obſervations have been particularized; for beſide what has been mentioned above, we meet with no very ancient obſervations of the Chineſe, except a winter ſolſtice in the year 1111, and a ſummer ſolſtice in the year 882, before Chriſt. Martini indeed ſpeaks of a ſummer ſolſtice 2342 years before that period. But M. Caſſini, who calculated it, found that there muſt have been an error in the Chineſe computation of 500 years at leaſt. An error of equal magnitude appears to have been committed in the conjunction of the five planets, which it is pretended they obſerved between the years 2513 and 2435 before Chriſt. In ſhort, ſome have ſuppoſed, that none of theſe are real obſervations, but the reſult of bungling calculations: and it has been hinted, but ſurely on too ſlight a foundation, that even thoſe good fathers themſelves were greatly to be ſuſpected. But let us come to things which are not conteſted.

"P. Gaubil informs us, that at leaſt 120 years before Chriſt, the Chineſe had determined by obſervation the number and extent of their conſtellations as they now ſtand; the ſituation of the fixed ſtars with reſpect to the equinoctial and ſolſtitial points; and the obliquity of the ecliptic. He farther ſays, he cannot tell by what means it is that they foretel eclipſes: but this is certain, that the theory by which they do predict them was ſettled about the ſame time; and that they were acquainted with the true length of the ſolar year, the method of obſerving meridian altitudes of the ſun by the ſhadow of a gnomon, and of learning from thence his declination and the height of the pole, long before. We learn, moreover, from the ſame miſſionary, that there are yet remaining among them ſome treatiſes of aſtronomy, which were written about 200 years before Chriſt; from which it appears, that the Chineſe had known the daily motion of the ſun and moon, and the times of the revolutions of the planets, many years before that period.

"We are informed by Du Halde, that, in the province of Honan, and city Teng-ſoang, which is nearly in the middle of China, there is a tower, on the top of which it is ſaid that *Toheou-cong*, the moſt ſkilful aſtronomer that ever China produced, made his obſervations. He lived 1200 years before Ptolemy, or more than 1000 years before Chriſt, and paſſed whole nights in obſerving the celeſtial bodies and arranging them into conſtellations. He uſed a very large braſs table placed perfectly horizontal, on which was fixed a long upright plate of the ſame metal, both of which were divided into degrees, &c. By theſe he marked the meridian altitudes; and from thence derived the times of the ſolſtices, which were their principal epocha."

Dr Long repreſents the ſtate of aſtronomy in China as at preſent very low; occaſioned, he ſays, principally by the barbarous decree of one of their emperors*, to have all the books in the empire burnt, * See *China*
excepting ſuch as related to agriculture and medicine. We are informed, however, by the Abbe Groſier, in his deſcription of China, that aſtronomy is cultivated in Peking in the ſame manner as in moſt of the capital cities of Europe. A particular tribunal is eſtabliſhed there, the juriſdiction of which extends to every thing relating to the obſervation of celeſtial phenomena. Its members are, an inſpector; two preſidents, one of them a Tartar and the other a Chineſe; and a certain number of mandarins who perform the duty of aſſeſſors; but for near a century and an half the place of the Chineſe preſident has been filled by an European. Since that time particular attention has been paid to the inſtruction of the aſtronomical pupils; and the preſidents have always conſidered it as their duty to make them acquainted with the ſyſtem and method of calculation made uſe of in Europe. Thus two-thirds of the aſtronomical pupils, maintained at the emperor's expence, in all about 200, have a tolerable notion of the ſtate of the heavens, and underſtand calculation ſo well as to be able to compoſe ephemerides of ſufficient exactneſs. The miſſionaries have never been the authors of any of theſe ephemerides: their employment is to reviſe the labours of the Chineſe mathematicians, verify their calculations, and correct any errors into which they have fallen. The Portugueſe miſſion ſtill continues to furniſh aſtronomers for the academy as it did at the firſt.

The aſtronomical tribunal is ſubordinate to that of ceremonies. When an eclipſe is to be obſerved, information muſt be given to the emperor of the day and hour, the part of the heavens where it will be, &c. and this intelligence muſt be communicated ſome months before it happen; the eclipſe muſt alſo be calculated for the longitude and latitude of the capital city of

every

every province of the empire. These observations, as well as the diagram which represents the eclipse, are preserved by the tribunal of ceremonies, and another called the *calao*, by whom it is transmitted to the different provinces and cities of the empire. Some days before the eclipse, the tribunal of ceremonies causes to be fixed up in a public place, in large characters, the hour and minute when the eclipse will commence; the quarter of the heavens in which it will be visible, with the other particulars relating to it. The mandarins are summoned to appear in state at the tribunal of astronomy, and to wait there for the moment in which the phenomenon will take place. Each of them carries in his hand a sheet of paper, containing a figure of the eclipse and every circumstance attending it. As soon as the observation begins to take place, they throw themselves on their knees, and knock their heads against the earth, and a horrid noise of drums and cymbals immediately commences throughout the whole city: a ceremony proceeding from an ancient superstitious notion, that by such noise they prevented the luminary from being devoured by the celestial dragon; and tho' this notion is now exploded in China, as well as every where else, such is the attachment of the people to ancient customs, that the ceremonial is still preserved. While the mandarins thus remain prostrated in the court, others, stationed on the observatory, examine, with all the attention possible, the beginning, middle, and end of the eclipse, comparing what they observe with the figure and calculations given. They then write down their observations, affix their seal to them, and transmit them to the Emperor; who on his part has been no less assiduous to observe the eclipse with accuracy. A ceremonial of this kind is observed throughout the whole empire.

The Japanese, Siamese, and inhabitants of the Mogul's empire, have also, from time immemorial, been acquainted with astronomy; and the celebrated observatory at BENARES, is a monument both of the ingenuity of the people and of their skill in this science.

4 Indian astronomy.

Mr. Bailly has been at great pains to investigate the progress of the Indians in astronomical knowledge, and gives a splendid account of their proficiency in the science, as well as of the antiquity of their observations. He has examined and compared four different astronomical tables of the Indian philosophers. 1. Of the Siamese, explained by M. Cassini in 1689. 2. Those brought from India by M. le Gentil of the Academy of Sciences. 3. and 4. Two other manuscript tables found among the papers of the late M. de Lisle. All of these tables have different epochs, and differ in form, being also constructed in different ways; yet they all evidently belong to the same astronomical system: the motions attributed to the sun and the moon are the same, and the different epochs are so well connected by the mean motions, as to demonstrate that they had only one, whence the others were derived by calculation. The meridians are all referred to that of Benares above mentioned. The fundamental epoch of the Indian astronomy is a conjunction of the sun and moon, which took place at no less a distance of time than 3102 years before the Christian æra. Mr Bailly informs us, that, according to our most accurate astronomical tables, a conjunction of the sun and moon actually did happen at that time. But though the bramins pretend to have ascertained the places of the two luminaries at that time, it is impossible for us at this time to judge of the truth of their assertions, by reason of the unequal motion of the moon; which, as shall afterwards be more particularly taken notice of, now performs its revolution in a shorter time than formerly.

Our author informs us, that the Indians at present calculate eclipses by the mean motions of the sun and moon observed 5000 years ago; and with regard to the solar motion, their accuracy far exceeds that of the best Grecian astronomers. The lunar motions they had also settled by computing the space through which that luminary had passed in 1,600,984 days, or somewhat more than 4383 years. They also make use of the cycle of 19 years attributed by the Greeks to Meton; and their theory of the planets is much better than that of Ptolemy, as they do not suppose the earth to be the centre of the celestial motions, and they believe that Mercury and Venus turn round the sun. Mr Bailly also informs us, that their astronomy agrees with the most modern discoveries of the decrease of the obliquity of the ecliptic, the acceleration of the motion of the equinoctial points, with many other particulars too tedious to enumerate in this place.

5 Astronomy of the Americans.

It appears also, that even the Americans were not unacquainted with astronomy, though they made use only of the solar, and not of the lunar motions, in their division of time. The Mexicans have had a strange predilection for the number 13. Their shortest periods consisted of 13 days; their cycle of 13 months, each containing 20 days; and their century of four periods of 13 years each. This excessive veneration for the number 13, according to Siguenza, arose from its being supposed the number of their greater gods. What is very surprising, though asserted as a fact by Abbé Clavigero, is that having discovered the excess of a few hours in the solar above the civil year, they made use of intercalary days, to bring them to an equality: but with this difference in regard to the method established by Julius Cæsar in the Roman kalendar, that they did not interpose a day every four years, but 13 days (making use here even of this favorite number) every 52 years, which produces the same regulation of time.

6 Of the Chaldeans and Egyptians.

Among those nations who first began to make any figure in ancient history, we find the Chaldeans and Egyptians most remarkable for their astronomical knowledge. Both of them pretended to an extravagant antiquity, and disputed the honour of having been the first cultivators of the science. The Chaldeans boasted of their temple of Belus; and of Zoroaster whom they placed 5000 years before the destruction of Troy: the Egyptians boasted of their colleges of Priests, where astronomy was taught; and of the monument of Osymandyas, in which we are told was a golden circle 365 cubits in circumference and one cubit thick. The upper face was divided into 365 equal parts, answering to the days of the year; and on every division were written the name of the day, and the heliacal rising of the several stars for that day, with the prognostications from their rising, principally, as Long conjectures, for the weather.

The Chaldeans certainly began to make observations very soon after the confusion of languages; for when Alexander the Great took Babylon, Callisthenes, by

Fig. 2

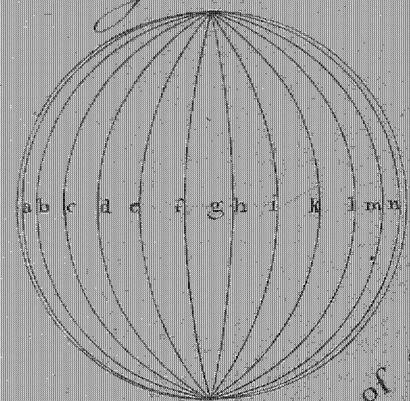


Fig. 3

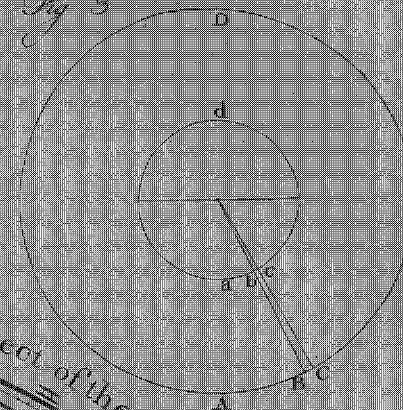


Fig. 1

The motion of Saturn Jupiter and Mars in respect of the Earth

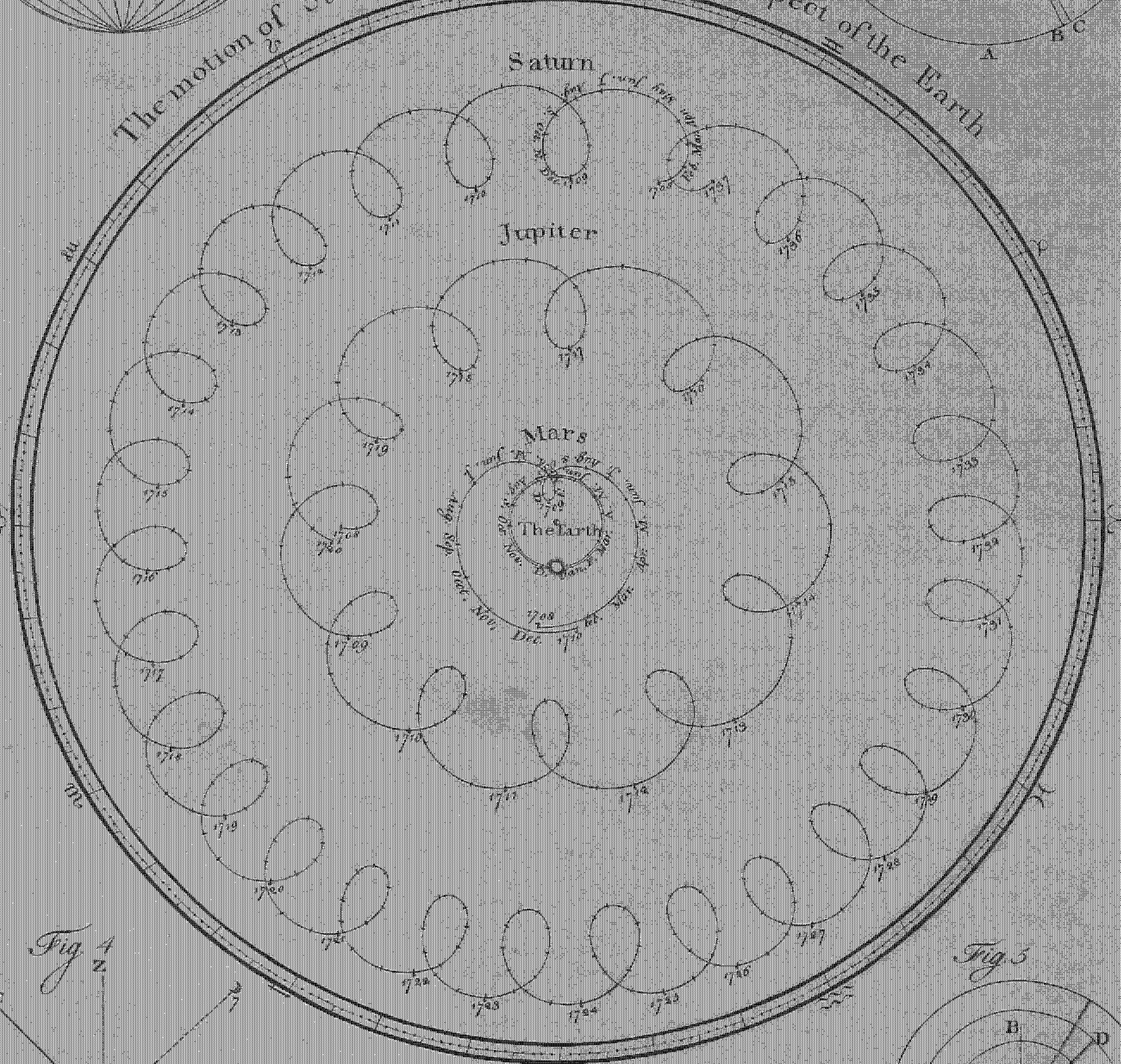


Fig. 4

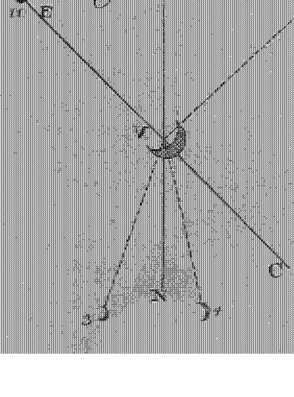
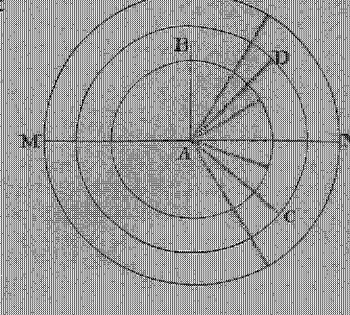


Fig. 5



Scot Philad^a

by his order, inquired after the aſtronomical obſervations recorded in that city, and obtained them for 1903 years back. Nothing, however, now remains of the Chaldean aſtronomy, excepting ſome periods of years which they had formed for the more ready computation of the heavenly bodies. But though they muſt have laboured under great diſadvantages, for want of proper inſtruments, in thoſe early ages, Gemina, as quoted by Petavius in his Uranologion, informs us, that they had determined, with tolerable exactneſs, the length both of a ſynodical and periodical month. They had alſo diſcovered, that the motion of the moon was not uniform, and even attempted to aſſign thoſe parts of her orbit in which it was quicker or ſlower. Ptolemy alſo aſſures us, that they were not unacquainted with the motion of the moon's nodes, and that of her apogee, ſuppoſing that the former made a complete revolution in 6585$\frac{1}{3}$ days, or 18 years 15 days and 8 hours; which period, containing 223 complete lunations, is called the Chaldean *Saros*. The ſame author alſo gives us, from Hipparchus, ſeveral obſervations of lunar eclipſes which had been made at Babylon about 720 years before Chriſt; but though he might very probably meet with many of a more ancient date, it was impoſſible to mention them particularly, on account of the imperfect ſtate of the Chaldean chronology, which commenced only with the æra of Nabonaſſar, 747 years before Chriſt. Ariſtotle likewiſe informs us, that they had many obſervations of the occultations of fixed ſtars and planets by the moon; and from hence, by a very natural and eaſy inference, they were led to conclude that the eclipſes of the ſun were occaſioned alſo by the moon, eſpecially as they conſtantly happened when the latter was in the ſame part of the heavens with the ſun. They had alſo a conſiderable ſhare in arranging the ſtars into conſtellations. Nor had the comets, by which aſtronomers in all ages have been ſo much perplexed, eſcaped their obſervation: for both Diodorus Siculus and Appollinus Myndius, in Seneca, informs us, that many of the Chaldeans held theſe to be laſting bodies, which have ſtated revolutions as well as the planets, but in orbits vaſtly more extenſive; on which account they are only ſeen by us while near the earth, but diſappear again when they go into the higher regions. Others of them were of opinion, that the comets were only meteors raiſed very high in the air, which blaze for a while, and diſappear when the matter of which they conſiſt is conſumed or diſperſed. Dialling was alſo known among them long before the Greeks were acquainted with any ſuch thing.

It is evident, indeed, that the countries both of Chaldea and Egypt were exceedingly proper for aſtronomical obſervations, on account of the general purity and ſerenity of the air. The tower or temple of Belus, which was of an extraordinary height, with ſtairs winding round it up to the top, is ſuppoſed to have been an aſtronomical obſervatory; and the lofty pyramids of Egypt, whatever they were originally deſigned for, might poſſibly anſwer the ſame purpoſe. Indeed theſe very ancient monuments ſhow the ſkill of this people in practical aſtronomy, as they are all ſituated with their four fronts exactly facing the cardinal points. Herodotus aſcribes the Egyptian knowledge in aſtronomy to Seſoſtris, whom Sir Iſaac Newton makes cotemporary with Solomon: but if this was the caſe, he could not be the inſtructor of the Egyptians in aſtronomical matters, ſince we find that Moſes, who lived 500 years before Solomon, was ſkilled in all the wiſdom of the Egyptians, in which we are undoubtedly to include aſtronomy.

From the teſtimony of ſome ancient authors, we learn that they believed the earth to be ſpherical, that they knew the moon was eclipſed by falling into its ſhadow, and that they made their obſervations with the greateſt exactneſs. They even pretended to foretel the appearance of comets, as well as earthquakes and inundations; which extraordinary knowledge is likewiſe aſcribed to the Chaldeans. They attempted to meaſure the magnitude of the earth and ſun; but the methods they took to find out the latter were very erroneous. It does not indeed appear with certainty that they had any knowledge of the true ſyſtem of the univerſe; and by the time of the Emperor Auguſtus, their aſtronomical knowledge was entirely loſt.

7 Of the Phenicians.

From Chaldea the ſcience of aſtronomy moſt probably paſſed into Phenicia; though ſame are of opinion that the Phenicians derived their knowledge of this ſcience from the Egyptians. They ſeem, however, to have been the firſt who applied aſtronomy to the purpoſes of navigation; by which they became maſters of the ſea, and of almoſt all the commerce in the world. They became adventurous in their voyages, ſteering their ſhips by one of the ſtars of the Little Bear; which being near the immoveable point of the heavens called the *Pole* is the moſt proper guide in navigation. Other nations made their obſervations by the Great Bear; which being too diſtant from the pole could not guide them in long voyages; and for this reaſon they never durſt venture far from the coaſts.

8 Aſtronomy of the Greeks.

The firſt origin of aſtronomical knowledge among the Greeks is unknown. Sir Iſaac Newton ſuppoſes that moſt of the conſtellations were invented about the time of the Argonautic expedition: but Dr Long is of opinion that many of them muſt have been of a much older date; and that the ſhepherds, who were certainly the firſt obſervers, gave names to them according to their fancy; from whence the poets invented many of their fables. Several of the conſtellations are mentioned by Heſiod and Homer, the two moſt ancient writers among the Greeks, who lived about 870 years before Chriſt; Heſiod deſiring the farmer to regulate the time of ſowing and harveſt by the riſing and ſetting of the Pleiades; and Homer informing us, that obſervations from the Pleiades, Orion, and Arcturus, were uſed in navigation. Their aſtronomical knowledge, however, was greatly improved by Thales the Mileſian, who travelled into Egypt, and brought from thence the firſt principles of the ſcience. He is ſaid to have determined the height of the pyramids by meaſuring their ſhadows at the time the ſun was 45 degrees high, and when of conſequence the lengths of the ſhadows of objects are equal to their perpendicular heights. But his reputation was raiſed to the higheſt pitch among his countrymen, by the prediction of an eclipſe, which happened juſt at the time that the armies of Alyattes king of Lydia, and Cyaxares the Mede, were about to engage; and being regarded as an evil omen by both parties, inclined them to

9 Improved by Thales.

to peace. To him Callimachus attributes the forming of the constellation of the little bear; the knowledge of which he certainly introduced into Greece. He also taught the true length of the year; determined the cosmical setting of the Pleiades in his time to have been 25 days after the autumnal equinox; divided the earth into five zones by means of the polar circles and tropics; taught the obliquity of the ecliptic; and showed that the equinoctial is cut by the meridians at right angles, all of which intersect each other at the poles. He is also said to have observed the exact time of the solstices, and from thence to have deduced the true length of the solar year; to have observed eclipses of the sun and moon; and to have taught that the moon had no light but what she borrowed from the sun. According to Stanley, he also determined the diameter of the sun to be one-720th part of his annual orbit. "But (says Dr Long) these things should be received with caution. There are some reasons which might be assigned for supposing that the knowledge of Thales in these matters was much more circumscribed: and indeed it is not unreasonable to suppose, that that veneration for the ancients which leads authors to write professedly on the history of ancient times, may have induced them to ascribe full as much knowledge to those who lived in them as was really their due."

10 By Anaximander, &c.

The successors of Thales, Anaximander, Anaximanes, and Anaxagoras, contributed considerably to the advancement of astronomy. The first is said to have invented or introduced the gnomon into Greece; to have observed the obliquity of the ecliptic; and taught that the earth was spherical, and the centre of the universe, and that the sun was not less than it. He is also said to have made the first globe, and to have set up a sun-dial at Lacedemon, which is the first we hear of among the Greeks; though some are of opinion that these pieces of knowledge were brought from Babylon by Pherycides, a cotemporary of Anaximander. Anaxagoras also predicted an eclipse which happened in the fifth year of the Peloponnesian war; and, taught that the moon was habitable, consisting of hills, valleys, and waters, like the earth. His cotemporary

11 Doctrines of Pythagoras.

Pythagoras, however, greatly improved not only astronomy and mathematics, but every other branch of philosophy. He taught that the universe was composed of four elements, and that it had the sun in the centre; that the earth was round, and had antipodes; and that the moon reflected the rays of the sun; that the stars were worlds, containing earth, air, and ether; that the moon was inhabited like the earth; and that the comets were a kind of wandering stars, disappearing in the superior parts of their orbits, and becoming visible only in the lower part of them. The white colour of the milky-way he ascribed to the brightness of a great number of small stars; and he supposed the distances of the moon and planets from the earth to be in certain harmonic proportions to one another. He is said also to have exhibited the oblique course of the sun in the ecliptic and the tropical circles, by means of an artificial sphere; and he first taught that the planet Venus is both the evening and morning star. This philosopher is said to have been taken prisoner by Cambyses, and thus to have become acquainted with all the mysteries of the Persian magi; after which he settled at Crotona in Italy, and founded the Italian sect.

About 440 years before the Christian æra, Philolaus, a celebrated Pythagorean, asserted the annual motion of the earth round the sun; and soon after Hicetas, a Syracusan, taught its diurnal motion on its own axis. About this time also flourished Meton and Euctemon at Athens, who took an exact observation of the summer solstice 432 years before Christ; which is the oldest observation of the kind we have, excepting what is delivered by the Chinese. Meton is said to have composed a cycle of 19 years, which still bears his name; and he marked the risings and settings of the stars, and what seasons they pointed out: in all which he was assisted by his companion Euctemon. The science, however, was obscured by Plato and Aristotle, who embraced the system afterwards called the *Ptolemaic*, which places the earth in the centre of the universe.

Eudoxus the Cnidian was a cotemporary with Aristotle, though considerably older, and is greatly celebrated on account of his skill in astronomy. He was the first who introdced geometry into the science, and he is supposed to be the inventor of many propositions attributed to Euclid. Having travelled into Egypt in the earlier part of his life, and obtained a recommendation from Agesilaus to Nectanebus king of Egypt, he, by his means, got access to the priests, who had the knowledge of astronomy entirely among them, after which he taught in Asia and Italy. Seneca tells us that he brought the knowledge of the planetary motions from Egypt into Greece; and Archimedes, that he believed the diameter of the sun to be nine times that of the moon. He was also well acquainted with the method of drawing a sun-dial upon a plane; from whence it may be inferred that he understood the doctrine of the projection of the sphere: yet, notwithstanding what has been said concerning the observations of Eudoxus, it is not certain that his sphere was not taken from one much more ancient, ascribed to Chiron the Centaur. The reason given for this supposition is, that had the places of the stars been taken from his own observations, the constellations must have been half a sign farther advanced than they are said to be in his writings.

Soon after Eudoxus, Calippus flourished, whose system of the celestial sphere is mentioned by Aristotle; but he is better known from a period of 76 years, containing four corrected metonic periods, and which had its beginning at the summer solstice in the year 330, before Christ. But about this time, or rather earlier, the Greeks having begun to plant colonies in Italy, Gaul, and Egypt, these became acquainted with the Pythagorean system, and the notions of the ancient Druids concerning astronomy. Julius Cæsar informs us, that the latter were skilled in this science; and that the Gauls in general were able sailors, which at that time they could not be without a competent knowledge of astronomy: and it is related of Pythoas, who lived at Marseilles in the time of Alexander the Great, that he observed the altitude of the sun at the summer solstice by means of a gnomon. He is also said to have travelled as far as Thule to settle the climates.

12 State of astronomy in Egypt after the death of Alexander.

After the death of Alexander the Great, sciences flourished in Egypt more than in any other part of the world; and a famous school was set up at Alexandria under the auspices of Ptolemy Philadelphus, a prince instructed in all kinds of learning, and the patron of all

all thoſe who cultivated them; and this ſchool continued to be the ſeminary of all kinds of literature, till the invaſion of the Saracens in 650. Timocharis and Aryſtillus, who firſt cultivated the aſtronomical ſcience in this ſchool, began to put it on a new footing; being much more careful in their obſervations, and exact in noting down the times when they were made, than their predeceſſors. Ptolemy aſſures us, that Hipparchus made uſe of their obſervations, by means of which he diſcovered that the ſtars had a motion in longitude of about one degree in an hundred years; and he cites many of their obſervations, the oldeſt of which is before the erection of this ſchool, in the year 295, when the moon juſt touched the northern ſtar in the forehead of the ſcorpion; and the laſt of them was in the 13th year of Philadelphus, when Venus hid the former ſtar of the four in the left wing of Virgo.

From this time the ſcience of aſtronomy continued greatly to advance. Ariſtarchus, who lived about 270 years before Chriſt, ſtrenuouſly aſſerted the Pythagorean ſyſtem, and gave a method of determining the diſtance of the ſun by the moon's dichotomy. Eratoſthenes, born at Cyrene in 271 B. C. determined the meaſure of a great circle of the earth by means of a gnomon. His reputation was ſo great, that he was invited from Athens to Alexandria by Ptolemy Euergetes, and made by him keeper of the royal library at that place. At his inſtigation the ſame prince ſet up thoſe armillas or ſpheres, which Hipparchus and Ptolemy the aſtronomer afterwards employed ſo ſucceſsfully in obſerving the heavens. He alſo found the diſtance between the tropics to be eleven ſuch parts as the whole meridian contains eighty-three. About the ſame time Beroſus, a native of Chaldea, flouriſhed at Athens. He is by ſome ſaid to have brought many obſervations from Babylon, which are aſcribed to the Greeks; while others contend, that the latter owe little or nothing of their aſtronomical knowledge to the Babylonians.

13 Diſcoveries of Archimedes.

The celebrated Archimedes, who next to Sir Iſaac Newton holds the firſt place among mathematicians, was nothing inferior as an aſtronomer to what he was as a geometrician. He determined the diſtance of the moon from the earth, of Mercury from the moon, of Venus from Mercury, of the ſun from Venus, of Mars from the ſun, of Jupiter from Mars, and of Saturn from Jupiter; as likewiſe the diſtance of the fixed ſtars from the orbit of Saturn. That he made aſtronomical obſervations, is not to be doubted; and it appears from an epigram of the poet Claudian, that he invented a kind of planetarium, or orrery, to repreſent the phenomena and motions of the heavenly bodies.

14 Of Hipparchus.

Hipparchus was the firſt who applied himſelf to the ſtudy of every part of aſtronomy, his predeceſſors having chiefly conſidered the motions and magnitudes of the ſun and moon. Ptolemy alſo informs us, that he firſt diſcovered the orbits of the planets to be eccentric, and on this hypotheſis wrote a book againſt Eudoxus and Calippus. He gives many of his obſervations; and ſays, that by comparing one of his with another made by Ariſtarchus 145 years before, he was enabled to determine the length of the year with great preciſion. Hipparchus alſo firſt found out the anticipation of the moon's nodes, the eccentricity of her orbit, and that ſhe moved ſlower in her apogee than in her perigee. He collected the accounts of ſuch ancient eclipſes as had been obſerved by the Chaldeans and Egyptians. He formed hypotheſes concerning the celeſtial motions, and conſtructed tables of thoſe of the ſun and moon, and would have done the ſame with thoſe of the other planets if he could have found ancient obſervations ſufficient for the purpoſe; but, theſe being wanting, he was obliged to content himſelf with collecting fit obſervations for that purpoſe, and endeavouring to form theories of the five planets. By comparing his own obſervations on the ſpica virginis with thoſe of Timochares at Alexandria made 100 years before, he diſcovered that the fixed ſtars changed their places, and had a ſlow motion of their own from weſt to eaſt. He corrected the Calippic period, and pointed out ſome errors in the method laid down by Eratoſthenes for meaſuring the circumference of the earth. By means of geometry, which was now greatly improved, he was enabled to attempt the calculation of the ſun's diſtance in a more correct manner than any of his predeceſſors; but unhappily it required ſo much accuracy in obſervation as was found impracticable.

15 Makes the firſt catalogue of fixed ſtars.

His greateſt work, however, was his catalogue of the fixed ſtars, which he was induced to attempt by the appearance of a new ſtar. The catalogue is preſerved by Ptolemy, and contains the longitudes and latitudes of 1022 ſtars, with their apparent magnitudes. He wrote alſo concerning the intervals between eclipſes both ſolar and lunar, and is ſaid to have calculated all that were to happen for no leſs than 600 years from his time.

16 Syſtem of Ptolemy.

Little progreſs was made in aſtronomy from the time of Hipparchus to that of Ptolemy, who flouriſhed in the firſt century. The principles on which his ſyſtem is built are indeed erroneous; but his work will always be valuable on account of the number of ancient obſervations it contains. It was firſt tranſlated out of the Greek into Arabic in the year 827, and into Latin from the Arabic in 1230. The Greek original was unknown in Europe till the beginning of the 15th century, when it was brought from Conſtantinople, then taken by the Turks, by George a monk of Trapezond, who tranſlated it into Latin. Various editions were afterwards publiſhed; but little or no improvement was made by the Greeks in this ſcience.

17 Aſtronomy of the Arabians.

During the long period from the year 800 to the beginning of the 14th century, the weſtern parts of Europe were immerſed in deep ignorance and barbarity. However, ſeveral learned men aroſe among the Arabians. The caliph Al Manſur was the firſt who introduced a taſte for the ſciences in his empire. His grandſon Al Mamun, who aſcended the throne in 814, was a great encourager of the ſciences, and devoted much of his own time to the ſtudy of them. He made many aſtronomical obſervations himſelf, and determined the obliquity of the ecliptic to be 23° 35′. He employed many able mechanics in conſtructing proper inſtruments, which he made uſe of for his obſervations; and under his auſpices a degree of the earth was meaſured a ſecond time in the plain of Singar, on the border of the Red Sea. From this time aſtronomy was ſtudiouſly cultivated by the Arabians; and Elements of Aſtronomy were written by Alferganus, who was partly cotemporary with the caliph Al Mamun. But the moſt celebrated of all their aſtronomers is Albategnius,

nius, who lived about the year of Christ 880. He greatly reformed astronomy, by comparing his own observations with those of Ptolemy. Thus he calculated the motion of the sun's apogee from Ptolemy's time to his own; determined the precession of the equinoxes to be one degree in 70 years; and fixed the sun's greatest declination at 23.35′. Finding that the tables of Ptolemy required much correction, he composed new ones of his own fitted to the meridian of Aracta, which were long held in estimation by the Arabians. After his time, though several eminent astronomers appeared among the Saracens, none made any very valuable observations for several centuries, excepting Ebn Younis astronomer to the caliph of Egypt: who observed three eclipses with such care, that by means of them we are enabled to determine the quantity of the moon's acceleration since that time.

Other eminent Saracen astronomers were, Arzachel a Moor of Spain, who observed the obliquity of the ecliptic, and constructed tables of sines, or half chords of double arcs, dividing the diameter into 300 parts; and Alhazen, his cotemporary, who first showed the importance of the theory of refractions in astronomy; writing also upon the twilight, the height of the clouds, and the phenomenon of the horizontal moon.

Ulug Beg, a grandson of the famous Tartar prince Timur Beg, or Tamerlane, was a great proficient in practical astronomy. He is said to have had very large instruments for making his observations; particularly a quadrant as high as the church of Sancta Sophia at Constantinople, which is 180 Roman feet. He composed astronomical tables from his own observations for the meridian of Samarcand his capital, so exact as to differ very little from those afterwards constructed by Tycho Brache; but his principal work is his catalogue of the fixed stars, made from his own observations in the year of Christ 1437. The accuracy of his observations may be gathered from his determining the height of the pole at Samarcand to be 39° 37′ 23″.

Besides these improvements, we are indebted to the Arabians for the present form of trigonometry. Manelaus, indeed, an eminent Greek astronomer who flourished about the year 90, had published three books of Spherics, in which he treated of the geometry necessary to astronomy, and which show great skill in the sciences; but his methods were very laborious, even after they had been improved and rendered more simple by Ptolemy: but Geber the Arabian, instead of the ancient method, proposed three or four theorems, which are the foundation of our modern trigonometry. The Arabians also made the practice still more simple, by using sines instead of the chords of double arcs. The arithmetical characters they had from the Indians.

18 Revival of astronomy in Europe.

During the greatest part of this time, almost all Europe continued ignorant not only of astronomy but of every other science. The emperor Frederick II. first began to encourage learning in 1230; restoring some universities, and founding a new one in Vienna. He also caused the works of Aristotle, and the Almagest or Astronomical Treatise of Ptolemy, to be translated into Latin; and from the translation of this book we may date the revival of astronomy in Europe. Two years after this publication, John de Sacro Bosco, or of Halifax, an Englishman, wrote his four books *De Sphæra*, which he compiled from Ptolemy Albategnius, Alferganus, and other Arabian astronomers: this work was so much celebrated, that for 300 years it was preferred in the schools to every other; and has been thought worthy of several commentaries, particularly by Clavius in 1531. In 1240, Alphonso king of Castile caused the tables of Ptolemy to be corrected: for which purpose he assembled many persons skilled in astronomy, Christians, Jews, and Moors; by whom the tables called *Alphonsine* were composed, at the expence of 40,000, or according to others 400,000 ducats. About the same time Roger Bacon, an English monk, published many things relative to astronomy; particularly of the places of the fixed stars, solar rays, and lunar aspects. Vitellio, a Polander, wrote a treatise on Optics about 1270, in which he showed the use of refractions in astronomy.

19 Improvements of Purbach.

From this time to that of Purbach; who was born in 1423, few or no improvements were made in astronomy. He wrote a commentary on Ptolemy's Almagest, some treatises on Arithmetic and Dialling, with tables for various climates. He not only used spheres and globes, but constructed them himself; and formed new tables of the fixed stars, reduced to the middle of that age. He composed also new tables of sines for every ten minutes, which Regiomontanus afterwards extended to every single minute, making the whole sine 60, with 6 ciphers annexed. He likewise corrected the tables of the planets, making new equations to them, because the Alphonsine tables were very faulty in this respect. In his solar tables he placed the sun's apogee in the beginning of Cancer; but retained the obliquity of the ecliptic 23° 33½′, to which it had been reduced by the latest observations. He made new tables for computing eclipses, of which he observed some, and had just published a theory of the planets, when he died in 1461.

20 Of Regiomontanus.

John Muller of Monteregio (Coningsberg), a town of Franconia, from whence he was called *Regiomontanus*, was the scholar and successor of Purbach. He completed the epitome of Ptolemy's Almagest which Purbach had begun; and after the death of the latter, went to Rome, where he made many astronomical observations. Having returned to Nuremberg in 1471, he was entertained by a wealthy citizen named *Bernard Walther*, who having a great love for astronomy, caused several instruments to be made under the direction of Regiomontanus, for observing the altitude of the sun and stars, and other celestial phenomena. Among these was an armillary astrolabe, like that which had been used by Hipparchus and Ptolemy at Alexandria, and with which many observations were made. He also made ephemerides for 30 years to come, showing the lunations, eclipses, &c. He wrote the Theory of the Planets and Comets, and a Treatise of Triangles yet in repute for several extraordinary cases. He is said to have been the first who introduced the use of tangents into trigonometry; and to have published in print (the art of printing having been lately invented) the works of many of the most celebrated ancient astronomers. After his death, which happened at Rome, Walther made a diligent search for all his instruments and papers which could be found; and continued his observations with the instruments he had till his death. The observations of both were collected by order of the senate of Nuremberg, and published there

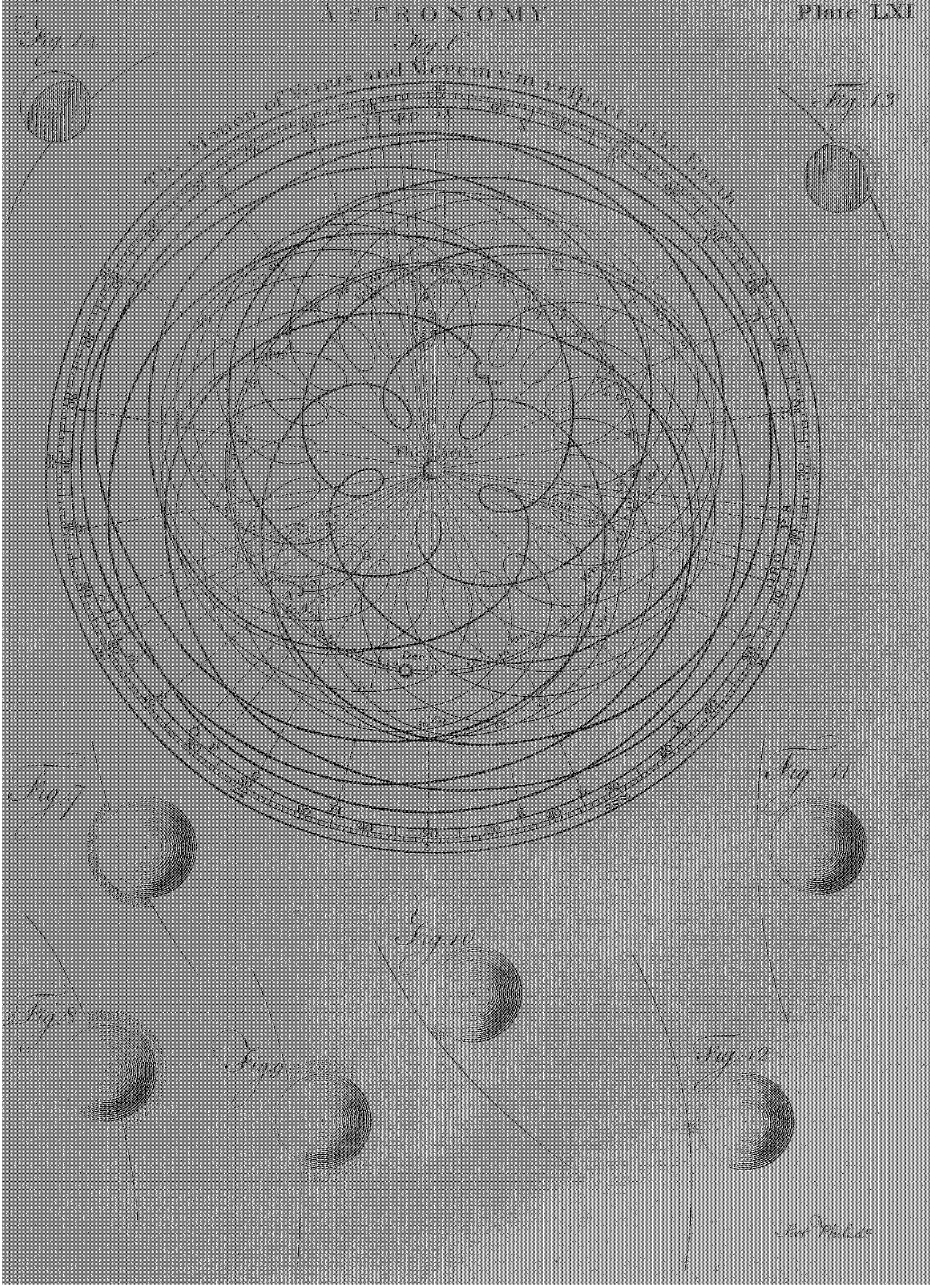


Fig. 6
The Motion of Venus and Mercury in respect of the Earth
The Earth
Venus
Mercury
Fig. 7
Fig. 8
Fig. 9
Fig. 10
Fig. 11
Fig. 12
Fig. 13
Fig. 14
Scot Philada

there by John Schoner in 1544; afterwards by Snellius at the end of the observations made by the Landgrave of Hesse in 1618; and lastly, in 1666, with those of Tycho Brache. Walther, however, as we are told by Snellius, found fault with his armilla, not being able to give any observation with certainty to less than ten minutes. He made use of a good clock, which also was a late invention in those days.

21 Of Werner

John Werner, a clergyman, succeeded Walther as astronomer at Nuremberg; having applied himself with great assiduity to the study of that science from his infancy. He observed the motion of the comet in 1500; and published several tracts, in which he handled many capital points of geometry, astronomy, and geography, in a masterly manner. He published a translation of Ptolemy's Geography, with a commentary, which is still extant. In this he first proposed the method of finding the longitude at sea by observing the moon's distance from the fixed stars; which is now so successfully put in practice. He also published many other treatises on mathematics and geography; but the most remarkable of all his treatises, are those concerning the motion of the eighth sphere or of the fixed stars, and a short theory of the same. In this he shewed by comparing his own observations of the stars regulus, spica virginis, and the bright star in the southern scale of the balance, made in 1514, with the places assigned to the same stars by Ptolemy, Alphonsus, and others, that the motion of the fixed stars, now called *the precession of the equinoctial points*, is one degree ten minutes in 100 years, and not one degree only, as former astronomers had made it. He made the obliquity of the ecliptic 23° 28′, and the first star of Aries 26° distant from the equinoctial point. He also constructed a planetarium representing the celestial motions according to the Ptolemaic hypothesis, and made a great number of meteorological observations with a view towards the prediction of the weather. The obliquity of the ecliptic was settled by Dominic Maria, the friend of Copernicus, at 23° 29′, which is still held to be just.

22 Pythagorean system restored by Copernicus

The celebrated Nicholaus Copernicus next makes his appearance, and is undoubtedly the great reformer of the astronomical science. He was originally bred to the practice of medicine, and had obtained the degree of Doctor in that faculty: but having conceived a great regard for the mathematical sciences, especially astronomy, he travelled into Italy, where he for some time was taught by Dominic Maria, or rather assisted him in his astronomical operations. On his return to his own country, being made one of the canons of the church, he applied himself with the utmost assiduity to the contemplation of the heavens, and to the study of the celestial motions. He soon perceived the deficiency of all the hypotheses by which it had been attempted to account for these motions; and for this reason he set himself to study the works of the ancients, with all of whom he also was dissatisfied excepting Pythagoras; who, as has been already related, placed the sun in the centre, and supposed all the planets, with the earth itself, to revolve round him. He informs us, that he began to entertain these notions about the year 1507; but not being satisfied with stating the general nature of his hypothesis, he became desirous of determining the several periodical revolutions of the planets, and thence of constructing tables of their motions which might be more agreeable to truth than those of Ptolemy and Alphonsus. The observations he was enabled to make, however, must have been extremely inaccurate; as he tells us, that if with the instruments he made use of he should be able to come within ten minutes of the truth, he would rejoice no less than Pythagoras did when he discovered the proportion of the hypothenuse to the other two sides of a right-angled triangle. His work was completed in the year 1530; but he could not be prevailed upon to publish it till towards the end of his life, partly through diffidence, and partly through fear of the offence which might be taken at the singularity of the doctrines set forth in it. At last, overcome by the importunities of his friends, he suffered it to be published at their expence, and under the inspection of Schoner and Osiander, with a dedication to Pope Paul III. and a preface, in which it was attempted to palliate as much as possible the extraordinary innovations it contained. During the time of its publication, the author himself was attacked by a bloody flux, succeeded by a palsy; so that he received a copy only a few hours before his death, which happened on the 23d of May 1543.

After the death of Copernicus, the astronomical science was greatly improved by Schoner, Nonius, Appian, and Gemma Frisius. Schoner survived Copernicus only four years; however, he greatly improved the methods of making celestial observations, reformed and explained the kalendar, and published a treatise of cosmography. Nonius had applied himself very early to the study of astronomy and navigation; but finding the instruments at that time in use excessively inaccurate, he applied himself to the invention of others which should be less liable to inconvenience. Thus he invented the astronomical quadrant, in which he divided the degrees into minutes by a number of concentric circles. The first of these was divided into 90 equal parts, the second into 89, the third into 88, and so on, as low as 46; and thus, as the index of the quadrant would always fall upon one or other of the divisions, or very near it, the minutes might be known by computation. He published many treatises on mathematical subjects, particularly one which detected the errors of Orontius, who had imagined that he could square the circle, double the cube, &c. by finding two mean proportionals betwixt two right lines. Appian's chief work was intitled *The Cæsarian Astronomy;* and was published at Ingoldstadt in 1540, dedicated to the emperor Charles V. and his brother Ferdinand. In this he showed how to resolve astronomical problems by means of instruments, without either calculations or tables; to observe the places of the stars and planets by the astrolabe; and to foretel eclipses and describe the figures of them; the whole illustrated with proper diagrams. In his second book he describes the method of dividing an astronomical quadrant, and of using it properly. His treatise concludes with the observation of five comets. Gemma Frisius wrote a commentary on a work of Appian, intitled his *Cosmography*, with many observations of eclipses. He invented also the astronomical ring, and several other instruments, which, though they could not boast of much exactness superior to others, were yet of considerable utility in taking observations

at

at ſea; and he is alſo memorable for being the firſt who propoſed a time-keeper for determining the longitude at ſea.—George Joachim Rheticus was a ſcholar of Copernicus, to attend whoſe lectures he gave up his profeſſorſhip of mathematics at Wittemberg. For the improvement of aſtronomical calculations, he began to conſtruct a table of ſines, tangents, and ſecants, for every minute and ten ſeconds of the quadrant. In this work he firſt ſhowed the uſe of ſecants in trigonometry, and greatly enlarged the uſe of tangents, firſt invented by Regiomontanus; but he aſſigned for the radius a much larger number of places than had been done before, for the greater exactneſs of calculation. This great work he did not live to accompliſh; but it was completed by his diſciple Valentine Otho, and publiſhed at Heidelberg in 1594.

23 Several illuſtrious perſons apply to the ſtudy of aſtronomy.

During this century, the liſt of aſtronomers was dignified by ſome very illuſtrious names. About the year 1561, William IV. Landgrave of Heſſe Caſſel, applied himſelf to the ſtudy of aſtronomy. With the aſſiſtance of Rothman and Burgius, the former an aſtronomer, the latter an excellent mathematical inſtrument maker, he erected an obſervatory on the top of his palace at Caſſel, and furniſhed it with ſuch inſtruments as were then in uſe, made in the beſt manner the artiſts of that age could execute. With theſe he made a great number of obſervations, which were by Hevelius preferred to thoſe of Tycho-Brache, and which were publiſhed by Snellius in 1618. From theſe obſervations he determined the longitudes and latitudes of 400 ſtars, which he inſerted in a catalogue where their places are rectified to the beginning of the year 1593.

24 Obſervations of Tycho-Brache.

Tycho-Brache began his obſervations about the ſame time with the Landgrave of Heſſe, already mentioned. He obſerved the great conjunction of Saturn and Jupiter in 1563; and finding the inſtruments he could procure very inaccurate, he made a quadrant capable of ſhewing ſingle minutes, and likewiſe a ſextant four cubits radius. In 1571, he diſcovered a new ſtar in the chair of Caſſiopeia; which induced him, like Hipparchus, to make a catalogue of the ſtars. This contained the places of 777 ſtars, rectified to the year 1600; but inſtead of the moon, which was uſed by the ancients to connect the places of the ſun and ſtars, Tycho ſubſtituted Venus as having little or no parallax, and yet being like the moon viſible both day and night. By the recommendation of the Landgrave of Heſſe, he obtained from the king of Denmark the iſland of Huenna, oppoſite to Copenhagen, where an obſervatory was built.

25 Account of Uraniburg, his obſervatory.

The firſt ſtone of this building, afterwards called *Uraniburg*, was laid in the year 1576. It was of a ſquare form, one ſide of it being about 60 feet in length; and on the eaſt and weſt ſides were two round towers of 32 feet diameter each. The inſtruments were more large and ſolid than had ever been ſeen before by any aſtronomer. They conſiſted of quadrants, ſextants, circles, ſemicircles, armillæ both equatorial and zodiacal, parallactic rulers, rings, aſtrolabes, globes, clocks, and ſun-dials. Theſe inſtruments were ſo divided as to ſhow ſingle minutes; and in ſome the arch might be read off to 10 ſeconds. Moſt of the diviſions were diagonal: but he had one quadrant divided according to the method invented by Nonius; that is, by 47 concentric circles. The whole expence is ſaid to have amounted to 200,000 crowns. The method of dividing by diagonals, which Tycho greatly admired, was the invention of Mr Richard Chanceller, an Engliſhman: Tycho, however, ſhows, that it is not accurately true when ſtraight lines are employed, and the circles at equal diſtances from each other; but that it may be corrected by making circular diagonals, which if continued would paſs through the centre.

Tycho employed his time at Uraniburg to the beſt advantage; but falling into diſcredit on the death of the king, he was obliged to remove to Holſtein, and at laſt found means to get himſelf introduced to the emperor, with whom he continued to his death. He is well known to have been the inventor of a ſyſtem of aſtronomy, which bears his name; and which he vainly endeavoured to eſtabliſh on the ruins of that of Copernicus; but the ſimplicity and evident conſonancy to the phenomena of nature, diſplayed in all parts of the Copernican ſyſtem, ſoon got the better of the unnatural and complicated ſyſtem of Tycho. His works, however, which are very numerous, diſcover him to have been a man of vaſt abilities. After his death the caſtle of Uraniburg quickly fell to decay, and indeed ſeems to have been purpoſely pulled down; for, in 1652, when Mr Huet went to Sweden, it was almoſt level with the ground, and few traces of the walls could be diſcerned. None of the neighbouring inhabitants had ever heard of the name of Tycho or Uraniburg, excepting one old man, whom Mr Huet found out with great difficulty, and who had been a ſervant in the family! All the diſcoveries of Purback, Regiomontanus, and Tycho, were collected and publiſhed in the year 1621, by Longomontanus, who had been Tycho's favourite ſcholar.

26 Diſcoveries of Kepler.

While Tycho reſided at Prague with the emperor, he invited thither John Kepler, afterwards ſo famous for his diſcoveries. Under the tuition of ſo great an aſtronomer, the latter quickly made an amazing progreſs. He found that his predeceſſors had erred in ſuppoſing the orbits of the planets to be circular, and their motions uniform: on the contrary, he perceived from his own obſervations, that they were elliptical, and their motions unequal, having the ſun in one of the foci of their orbits; but that, however, they varied in abſolute velocity, a line drawn from the centre of the ſun to the planet, and revolving with it, would always deſcribe equal areas in equal times. He diſcovered, in the year 1618, that the ſquares of the periodical times are as the cubes of the diſtances of the planets; two laws which have been of the greateſt importance to the advancement of aſtronomy. He ſeems to have had ſome notion of the extenſive power of the principle of gravity: for he tells us, that gravity is a mutual power betwixt two bodies; that the moon and earth tend towards each other, and would meet in a point nearer the earth than the moon in the proportion of the ſuperior magnitude of the former, were they not hindered by their projectile motions. He adds alſo, that the tides ariſe from the gravitation of the waters towards the moon: however, he did not adhere ſteadily to theſe principles, but afterwards ſubſtituted others as the cauſes of the planetary motions.

Cotemporary with Kepler were Mr Edward Wright, and Napier baron of Merchiſton. To the former we owe ſeveral very good meridional obſervations of the ſun's sun's altitude, made with a quadrant of six feet radius, in the years 1594, 1595, and 1596; from which he greatly improved the theory of the sun's motion, and computed more exact tables of his declination than had been done by any person before. He published also in 1599, an excellent Treatise, entitled, "Certain Errors in Navigation discovered and detected." To the latter we are indebted for the knowledge of logarithms; a discovery, as was justly observed by Dr Halley, one of the most useful ever made in the art of numbering. John Bayer, a German, who lived about the same time, will ever be memorable for his work, entitled, *Uranometria*, which is a very complete celestial atlas, or a collection of all the constellations visible in Europe. To this he added a nomenclature, in which the stars in each constellation are marked with the letters of the Greek alphabet; and thus every star in the heavens may be referred to with the utmost precision and exactness. About the same time also, astronomy was cultivated by many other persons; abroad, by Maginus, Mercator, Maurolycus, Homelius, Schultet, Stevin, &c.; and by Thomas and Leonard Digges, John Dee, and Robert Flood, in England; but none of them made any considerable improvement.

27 Invention of telescopes and consequent discoveries.

The beginning of the 17th century was distinguished not only by the discovery of logarithms, but by that of telescopes, a sort of instruments by which astronomy was brought to a degree of perfection utterly inconceivable by those who knew nothing of them. The question concerning the inventor is discussed under the article OPTICS; but whoever was entitled to this merit, it is certain that Galileo was the first who brought them to such perfection as to make any considerable discoveries in the celestial regions. With instruments of his own making, Galileo discovered the inequalities in the moon's surface, the satellites of Jupiter, and the ring of Saturn; though this last was unknown to him after he had seen it, and the view he got made him conclude that the planet had a threefold body, or that it was of an oblong shape like an olive. He discovered spots on the sun, by means of which he found out the revolution of that luminary on his axis; and he discovered also that the milky way and nebulæ were full of small stars. It was not, however, till some time after these discoveries were made that Galileo and others thought of applying the observations on Jupiter's satellites to the purpose of finding the longitude of places on the surface of the earth; and even after this was thought of, astronomers found it so difficult to construct tables of their motions, that it was not till after many observations had been made in distant places of the world, that Cassini was able to determine what positions of the satellites were most proper for finding out the longitude. At last he perceived that the entrance of the first satellite into the shadow of Jupiter, and the exit of it from the same, were the most proper for this purpose: that next to these the conjunctions of the satellites with Jupiter, or with one another, may be made use of; especially when any two of them, moving in contrary directions, meet with each other: and lastly, that observations on the shadows of the satellites, which may be seen on the disk of Jupiter, are useful, as also the spots which are seen upon his face, and are carried along it with greater velocity than has hitherto been discovered in any of the other heavenly bodies.

28 Logarithmic tables composed.

While astronomers were thus busy in making new discoveries, the mathematicians in different countries were no less earnestly employed in constructing logarithmic tables to facilitate their calculations. Benjamin Ursinus, an excellent mathematician of Brandenburg, calculated much larger tables of logarithms than had been done by their noble inventor, and published them in 1625. They were improved by Henry Briggs, Savilian professor of Oxford; who by making unity the logarithm of ten, thus rendered them much more convenient for the purposes of calculation. Logarithmic tables of sines and tangents were also composed by Mr Briggs and Adrian Vlacq at Goude, so that the business of calculation was now rendered nearly as easy as possible.

29 Transit of Venus first discovered by Mr Horrox.

In 1633, Mr Horrox, a young astronomer of very extraordinary talents, discovered that Venus would pass over the disk of the sun on the 24th of November 1639. This event he announced only to one friend, a Mr Crabtree; and these two were the only persons in the world who observed this transit the first time it had ever been viewed by human eyes. Mr Horrox made many useful observations at the time; and had even formed a new theory of the moon, so ingenious as to attract the notice of Sir Isaac Newton; but the hopes of astronomers from the abilities of this excellent young man were blasted by his death in the beginning of January 1640.

30 Foundation of the academy of sciences at Paris and Royal Society at London.

About the year 1638 many learned men began to assemble at Paris in order to hold conferences on different scientific subjects, which was the first foundation of the Royal Academy of Sciences in that capital. This practice was introduced in France by Mersennus, and soon after at London by Oldenburg; which laid the foundation of the Royal Society there. About this time also the celebrated astronomer Hevelius flourished at Dantzic, building an observatory in his own house, and furnishing it with excellent instruments of his own construction; particularly octants and sexants of brass of three and four feet radius, as well as telescopes, with which he constantly observed the spots and phases of the moon, and from which observations he afterwards compiled his excellent and beautiful work intitled *Selenographia*. This noble building, together with all the books and instruments it contained, was consumed by fire on the 26th of September 1679; but the memory, as well as the form and construction of the instruments, is preserved in a curious work of the ingenious inventor, intitled *Machina Cœlestis*; though almost the whole impression of this book was involved in the same fate with the instruments it describes. The damage sustained on this occasion was estimated at 30,000 crowns.

The celebrated English mechanic Dr Hooke, who was cotemporary with Hevelius, had in the mean time invented instruments with telescopic sights, which he preferred to those used by Hevelius so much, that a dispute commenced, which procured Hevelius a visit from Dr Halley. The latter had at that time taken a voyage to St Helena at the desire of the Royal Society, in order to observe and form a catalogue of the stars in the southern hemisphere. The result of his observations with Hevelius's instruments was, that three several observations on the Spica Virginis and Regulus differed only a few seconds from each other. They were the invention of Tyco-Brache, and are described

deſcribed under the article Optics. At this viſit Halley and Hevelius obſerved on occultation of Jupiter by the moon, and determined the diameter of the latter to be 30′. 33″.

In 1671 the Royal Obſervatory in Paris was finiſhed, and the uſe of it aſſigned to Mr Caſſini, after it had been furniſhed with inſtruments at a very great expence: and the obſervatory at Greenwich being likewiſe built five years after, Mr Flamſtead was appointed aſtronomer-royal. The obſervations in both theſe places, however, have been ſo numerous, that it is in vain to attempt any account of them.

31 Improvements in teleſcopes.

Before the middle of the 17th century the conſtruction of teleſcopes had been greatly improved, particularly by Fontana and Huygens. The latter conſtructed one of 123 feet, which is ſtill preſerved in the muſeum of the Royal Society at London. With this he obſerved the moon and planets for a long time, and diſcovered that Saturn was encompaſſed with a ring. The French, however, ſtill outdid the Engliſh artiſts; and by means of teleſcopes of 200 and 300 feet focus, M. Caſſini was enabled to ſee all the five ſatellites of Saturn, his belts, and the ſhadows of Jupiter's ſatellites paſſing over his body. In 1666 M. Azout applied a micrometer to teleſcopes for the purpoſe of meaſuring the diameters of the planets, and ſmall diſtances in the heavens; however an inſtrument of this kind had been before invented by Mr Gaſcoine, though it was but little known abroad.

Notwithſtanding all theſe diſcoveries by means of teleſcopes, it was evident that they ſtill continued in a very imperfect ſtate, and their imperfections at the time appeared to be without remedy. One defect was the enormous length requiſite to admit of any very conſiderable magnifying power; and another was the incorrectneſs of the image ariſing from the aberration of the rays, as was then ſuppoſed, by the ſpherical figure of the glaſs. To obviate theſe inconveniences, Merſennus is ſaid to have firſt propoſed, in a letter to Deſcartes, the uſe of reflectors inſtead of lenſes in the conſtruction of teleſcopes; but this he did in ſuch an obſcure manner, that the latter laboured to perſuade him of the falſehood of the principle on which his ſcheme was founded. In 1663, however, James Gregory of Aberdeen ſhowed how ſuch a teloſcope might be conſtructed. He ſhowed alſo, that in order to form a perfect image of an object in this manner, the figure of the ſpeculum ought to be parabolic; but Sir Iſaac Newton, who applied himſelf to the framing of teleſcopes of the reflecting kind, found it impracticable to grind them of the deſired figure. Laying aſide the idea of reflecting teleſcopes, therefore, he applied himſelf to the execution of a ſcheme formed by Deſcartes, viz. that of grinding lenſes of the figure of one of the conic ſections. In proſecuting this plan, he diſcovered, that the greateſt errors to which teleſcopes were ſubject aroſe from the different refrangibility of the rays of light, for which he could not then find any remedy. He therefore returned to the ſcheme he had juſt abandoned; and, in the year 1672, preſented to the Royal Society two reflectors which were conſtructed with ſpherical ſpeculums, as he could not procure any other. The inconveniences ariſing from the different refrangibility of the rays of light, have ſince been in the fulleſt manner corrected by Mr Dolland, the excellency of whoſe achromatic teleſcopes are too well known to need any encomium.

About the beginning of the preſent century, the practical part of aſtronomy ſeemed to languiſh for want of proper inſtruments. Roemer, indeed, had invented ſome new ones, and Dr Hooke had turned his attention towards this ſubject in a very particular manner; but either through want of ſkill in the artiſts, or ſome other unfortunate circumſtance, it happened that nothing effectual was done. But at the very time when this was the caſe with practical aſtronomy, the ſpeculative part was carried in a manner to its utmoſt pitch by the labours of the immortal Newton, whoſe Principia gave an entire new face to the ſcience. It was not, however, for many years reliſhed by the foreign philoſophers, though almoſt immediately adopted at home, and has continued ever ſince to ſpread its reputation farther and farther, ſo that now it is in a manner eſtabliſhed all over the world. "But (ſays Dr. Long) that, after Newton's ſyſtem had for ſo long a time been neglected, it ſhould all at once be univerſally received and approved of, is not to be attributed to chance, or the caprice of faſhion, as ſome who are ignorant of it are apt to think; and from thence to expect that ſome other ſyſtem will hereafter take its place and bury it in oblivion. The ſyſtem of Newton, like that of Copernicus, is ſo agreeable to the phenomena of nature, and ſo well put together, that it *muſt* laſt as long as truth and reaſon endure, although time may perhaps bring the word attraction into diſuſe; and though it may no longer be thought inherent in matter, yet the laws of gravitation, as they are now called, and on which this ſyſtem is founded, will never be forgotten.".

32 Aſtronomical inſtruments firſt improved in England

It was alſo in Britain that the firſt improvements in aſtronomical inſtruments took place. The celebrated mechanic and watchmaker Graham, carried the accuracy of his inſtruments to a degree which ſurpriſed every one. He alſo greatly improved the principles of watchwork, and made clocks to go with much greater regularity than before. The old eight feet mural arch at Greenwich was alſo conſtructed by him; as was a ſmall equatorial ſector for making obſervations out of the meridian: but he is chiefly remarkable for contriving the zenith ſector of 24 feet radius, and afterwards one of 12½ feet, by which Dr Bradley diſcovered the aberration of the fixed ſtars. The reflecting teleſcope which had been invented by Gregory, and executed by Newton, was greatly improved by Mr Hadley, and a very complete and powerful inſtrument of that kind was preſented to the Royal Society in 1719. The ſame gentleman has alſo immortalized his memory by the invention of the reflecting quadrant, which he preſented to the Society in 1731, which is now in univerſal uſe at ſea; and without which all improvements of the lunar theory would have been uſeleſs for determining the longitude, through the want of an inſtrument proper to make the obſervations with. It however appears, that an inſtrument, exactly ſimilar to this in its principles, had been invented by Sir Iſaac Newton; and a deſcription of it, together with a drawing, given by the inventor to Dr Halley, when he was preparing for his voyage to diſcover the variation of the needle

needle in 1701. About the middle of this century, the constructing and dividing of large astronomical instruments was carried to a great degree of perfection by Mr John Bird: reflecting telescopes were equally improved by Mr Short, who first executed the divided object-glass micrometer. This had indeed been thought of by M. Louville, and several other persons long before; and a description of one nearly agreeing with that of Mr Short had been published in the Philosophical Transactions for 1753: but had it not been for the great skill of Mr Short in figuring and centering glasses of this kind, it is very probable the scheme might never have been executed. About this time also Mr Dollond brought refracting telescopes to such perfection, that they became superior to reflectors of equal length; though all of them are now excelled by those of Mr Herschel, whose Telescopic discoveries have been far more numerous and surprising than those of any other astronomer.

33 Improvements within this last century

We shall close this history with a short account of the labours of the principal astronomers since the building the Royal Observatories at Paris, Greenwich, and the appointment of Mr Flamstead to the office of astronomer royal. This gentleman not only made observations on the sun, moon, planets, and comets which appeared in his time, but on the fixed stars also, of which he gave a catalogue of 3000: many of them so small that they cannot be discerned without the help of a telescope: he also published new solar tables, and a theory of the moon according to Horrox. He published a very curious tract on the doctrine of the sphere, in which he showed how to construct eclipses of the sun and moon, as well as occultations of the fixed stars by the moon geometrically; and it was upon his observations that Halley's tables and Newton's theory of the moon were constructed. Mr Cassini also distinguished himself very considerably. He erected the gnomon, and drew the famous meridian line in the church of Petronia at Borunia. He enjoyed his office more than 40 years, making many observations on the sun, moon, planets, and comets, and greatly amended the elements of their motions. The office was continued in his family, and his grandson still enjoys it. Rœmer, a celebrated Danish astronomer, first discovered the progressive motion of light by observing the eclipses of Jupiter, and read a dissertation upon it before the Royal Academy of Sciences at Paris in the year 1675. He was also the first who made use of a meridional telescope.

Mr Flamstead was succeeded in 1719 by Dr Halley, "the greatest astronomer (says M. de la Lande) without contradiction in England;" and, adds Dr Long, "I believe he might have said in the whole world." He had been sent, at the age of 21, by King Charles II. to the island of St Helena, in order to make a catalogue of the southern stars, which was published in 1679. In 1705, he published his *Synopsis Astronomiæ Cometicæ*, in which, after immense calculation, he ventured to predict the return of one in 1758 or 1759. He also published many learned dissertations in the Philosophical Transactions concerning the use that might be made of the next transit of Venus in determining the distance of the sun from the earth. He was the first who discovered the acceleration of the moon, and gave a very ingenious method of finding her parallax by three observed phases of a solar eclipse. He composed tables of the sun, moon, and all the planets; and, in the nine years in which he was at Greenwich, made near 1500 observations of the moon; all which he compared with the tables, and noted the differences; and these, he thought, would return in about 18 years. He recommended the method of determining the longitude by means of the moon's distance from the sun and certain fixed stars. He was convinced of its superior excellence; and it has since been adopted by all the most eminent astronomers in Europe. It is at present the only sure guide to the mariner; and the great perfection to which it is now brought is much owing to the industry and exertions of Dr Maskelyne, the present astronomer-royal, to whom we are indebted for the publication of the Nautical Almanac, the Requisite Tables, and other works of the utmost service to practical astronomy.

34 True figure of the earth discovered.

In the mean time an attempt was made in France to measure a degree of the earth, which occasioned a very warm dispute concerning the figure of it. Cassini, from Picart's measure, concluded that the earth was an oblong spheroid; but Newton, from a consideration of the laws of gravity and the diurnal motion of the earth, had determined the figure of it to be an oblate spheroid, and flatted at the poles. To determine this point, Lewis XV. resolved to have two degrees of the meridian measured; one under, or very near the equator; and the other as near the pole as possible. For this purpose the Royal Academy of Sciences sent M. Maupertuis, Clairault, Camus, and Le Monier, to Lapland. They were accompanied by the Abbé Outhier, a correspondent of the same academy. They were joined by M. Celsius professor of anatomy at Upsal; and having set out from France in the spring of the year 1736, returned to it in 1737, after having fully accomplished their errand. On the southern expedition were dispatched M. Godin, Condamine, and Bouguer, to whom the king of Spain joined Don George Juan and Don Anthony de Ulloa, two very ingenious gentlemen and officers of the marine. They left Europe in 1735; and after enduring innumerable hardships and difficulties in the execution of their commission, returned to Europe at different times, and by different ways, in the years 1744, 1745, and 1746. The result of this arduous task was a confirmation of Newton's investigation. Picart's measure was revised by Cassini and De la Caille; and, after his errors were corrected, it was found to agree very well with the other two. On this occasion too it was discovered, that the attraction of the great mountains of Peru had an effect on the plumb-line of one of their largest instruments, drawing it seven or eight seconds from the true perpendicular.

Dr Halley, dying in 1742, was succeeded by Dr Bradley, who, though inferior as a mathematician, greatly exceeded him as a practical astronomer. He was the first who made observations with an accuracy sufficient to detect the lesser inequalities in the motions of the planets and fixed stars. Thus he discovered the aberration of light, the nutation of the earth's axis, and was able to make the lunar tables much more perfect than they had ever been. He also observed the places, and computed the elements of the comets which appeared

peared in the years 1723, 1736, 1743, and 1757. He made new and most accurate tables of the motions of Jupiter's satellites, from his own observations and those of Dr Pound; and from a multitude of observations of the sun, moon, and stars, was enabled to give the most accurate table of mean refractions yet extant, as well as the best methods of computing the variations of those refractions arising from the different states of the air as indicated by the thermometer and barometer. In 1750, having procured a very large transit instrument made by Mr Bird, and a new mural quadrant of brass eight feet radius, he began to make observations with redoubled industry; so that betwixt this time and his death, which happened in 1762, he made observations for settling the places of all the stars in the British catalogue, together with near 1500 places of the moon, much the greater part of which he compared with the tables of Mr Mayer.

35 Improvements by the French astronomers.

In the mean time the French astronomers were assiduous in their endeavours to promote the science of astronomy. The theory of the moon, which had been given in a general way by Sir Isaac Newton, began to be particularly considered by Messrs Clairault, D'Alembert, Euler, Mayer, Simpson, and Walmsly; tho' Clairault, Euler, and Mayer, distinguished themselves beyond any of the rest, and Mr Euler has been particularly happy in the arrangement of his tables for the ease and expedition of computation. He was excelled in exactness, however, by Mayer, who published his tables in the Gottingen Acts for 1753. In these the errors in longitude never exceeded two minutes; and having yet farther improved them, he sent a copy to the lords of the British admiralty in 1755; and it was this copy which Dr Bradley compared with his observations, as already mentioned. His last corrections of them were afterwards sent over by his widow; for which she and her children received a reward of L.3000. Accurate tables for Jupiter's satellites were also composed by Mr Wargentin a most excellent Swedish astronomer, and published in the Upsal Acts in 1741; which have since been corrected by the author in such a manner as to render them greatly superior to any ever published before.

36 Of M. de la Caille.

Amongst the many French astronomers who contributed to the advancement of the science, we are particularly indebted to M. de la Caille, for a most excellent set of solar tables, in which he has made allowances for the attractions of Jupiter, Venus, and the moon. In 1750 he went to the Cape of Good Hope, in order to make observations in concert with the most celebrated astronomers in Europe, for determining the parallax of the moon, as well as of the planet Mars, and from thence that of the sun; from whence it appeared that the parallax of the sun could not greatly exceed 10 seconds. Here he re-examined and adjusted the places of the southern stars with great accuracy, and measured a degree of the meridian at that place. In Italy the science was cultivated with the greatest assiduity by Signior Bianchini, father Boscovich, Frisi, Manfredi, Zanotti, and many others; in Sweden by Wargentin already mentioned, Blingenstern, Mallet, and Planman; and in Germany, by Euler elder and younger, Mayer, Lambert, Grischow, &c. In the year 1760 all the learned societies in Europe began to prepare for observing the transit of Venus over the sun, foretold by Dr Halley upwards of 80 years before it happened, showing at the same time the important use which might be made of it. Unfortunately, however, for the cause of science, many of the astronomers sent out to observe this phenomenon were prevented by unavoidable accidents from reaching the places of their destination, and others were disappointed by the badness of the weather. It happened also, that the circumstances of the phenomenon were much less favourable for the purpose of determining the sun's parallax than had been expected by Dr Halley, owing to the faults of the tables he made use of: so that, notwithstanding all the labours of astronomers at that time, they were not able to determine the matter; and even after their observations in 1769, when the circumstances of the transit were more favourable, the parallax of the sun remained still uncertain.

Dr Bradley was succeeded in his office of astronomer-royal by Mr Bliss Savilian professor of astronomy at Oxford; who being in a very declining state of health at the time of his accession to the office, did not enjoy it long. He was succeeded by the learned Nevil Maskelyne, D. D. the present astronomer-royal, whose name will be rendered immortal by his assiduity and success in bringing the lunar method of determining the longitude at sea into general practice.

Such was the general state of astronomy, when Mr Herschel's great discovery of augmenting the power of telescopes, beyond the most sanguine hopes of astronomers, opened at once a scene altogether unlooked for. By this indefatigable observer we are made acquainted with a new primary planet attended by two secondaries belonging to our solar system; so that the latter now appears to have double the bounds formerly assigned to it; this new planet being at least twice the distance of Saturn from the sun. In the still farther distant celestial regions, among the fixed stars, his observations are equally surprising; of which we shall only say with Dr Priestley *, "Mr Herschel's late discoveries in and beyond the bounds of the solar system, the great views that he has given of the arrangement of the stars, their revolutions, and those of the immense systems into which they are formed, are peculiarly calculated to inspire an ardent desire of seeing so great a scene a little more unfolded. Such discoveries as these give us a higher idea of the value of our being, by raising our ideas of the system of which we are a part; and with this an earnest wish for the continuance of it."

* *Exper. and Observ.* vol. vi. Pref.

Sect. I. *Of the apparent Motions, Magnitudes, and Changes, in the celestial Bodies, as seen by the naked eye.*

As the true motions of bodies at a great distance are to be gathered only from a careful observation of their apparent ones, it is absolutely necessary for those who want to become acquainted with the true motions of the heavenly bodies, to know perfectly the different changes which take place in the heavens as seen from this earth, the only place from which any observation can

Apparent Motion, &c.

can be made. By carefully attending to these, a little knowledge of optics will enable us to understand with great certainty not only the true system of nature, but also what appearance the heavens would make to a spectator placed in any part of the visible creation.

37 **Apparent motion of the sun.**

The first and most obvious phenomenon is the daily rising of the sun in the east, and his setting in the west; after which the moon and stars appear, still keeping the same westerly course, till we lose sight of them altogether. This cannot be long taken notice of before we must likewise perceive that neither the sun nor moon always rise exactly in the same point of the heavens. If we begin to observe the sun, for instance, in the beginning of March, we will find that he seems to rise almost every day sensibly more to the northward than he did the day before, to continue longer above the horizon, and to be more vertical at mid-day. This continues till towards the end of June, when he is observed to move backward in the same manner; and this retrograde motion continues to the end of December, or near it, when he begins again to move forwards, and so on.

38 **Of the moon.**

The motion of the moon through the heavens, as well as her appearance at different times, is still more remarkable than those of the sun. When she first becomes visible at the time she is called the *new moon*, she appears in the western part of the heavens, and seems to be at no great distance from the sun himself. Every night she not only increases in size, but removes to a greater distance from the sun; till at last she appears in the eastern part of the horizon, just at the time the sun disappears in the western. After this she gradually moves farther and farther eastward, and therefore rises every night later and later, till at last she seems to approach the sun as nearly in the east as she did in the west, and rises only a little before him in the morning, as in the first part of her course she set in the west not long after him. All these different appearances are completed in the space of a month; after which they begin in the same order as before. They are not, however, at all times regular; for at some seasons of the year, particularly in harvest, the moon for several days rises nearly at the same hour every night.

39 **Of the stars.**

In contemplating the stars, it is observed that some of them have the singular property of neither rising in the east nor setting in the west; but seem to turn round one immoveable point, near which is placed a single star called the *pole*, or *pole-star*. This point is more or less elevated according to the different parts of the earth from which we take our view. The inhabitants of Lapland, for instance, see it much more elevated above the horizon, or more vertical, than we do; we see it more vertical than it appears to the inhabitants of France and Spain; and they, again, see it more elevated than the inhabitants of Barbary. By continually travelling south, this star would at length seem depressed in the horizon, and another point would appear directly opposite to it, round which the stars in the southern part of the horizon would seem to turn. In this part of the heavens, however, there is no star so near the pole as there is in the northern part; neither is the number of stars in the southern part of the heavens so great as in the northern. Supposing us still to travel southward, the north-pole would then entirely disappear, and the whole hemisphere would appear to turn round a single point in the south, as the northern hemisphere appears to us to turn round the pole-star.—The general appearance of the heavens, therefore, is that of a vast concave sphere, turning round two points fixed in the north and south parts of it, once in 24 hours.

40 **Fixed stars and planets**

When we further consider the stars, we will find the greatest part of them to keep their places with respect to one another; that is, if we observe two stars having a certain apparent distance from each other this night, they will seem to have the same to-morrow, and every other succeeding night; but we will by no means observe them to have the same places either with respect to the sun or moon, as must be easily understood from what we have already said. Neither do all the stars in the heavens appear to be of this fixed kind. Some of them, on the contrary, change their places very remarkably with regard to the fixed stars, and with regard to one another. Of these, five were only observed formerly; but Mr Herschel has now discovered a sixth. They are distinguished by the appellation of *planets*, (from πλανω, to *err* or *wander*); and called by the names of *Mercury*, *Venus*, *Mars*, *Jupiter*, *Saturn*, and the *Georgium Sidus*. The fixed stars are likewise distinguished from the planets by their continually exhibiting that appearance which is called the *scintillation* or *twinkling of the stars*. This is said to arise from the exceeding minuteness of their apparent diameter; so that the interposition of any little substance, of which there are many floating in the atmosphere, continually deprives us of the sight of them; but the interposing body soon changing its place, we again see the star, and thus the twinkling is produced.

Mercury is a small star, but emits a very bright white light; though by reason of his always keeping near the sun, he is seldom to be seen; and when he does makes his appearance, his motion towards the sun is so swift, that he can only be discerned for a short time. He appears a little after sunset, and again a little before sunrise.

Venus, the most beautiful star in the heavens, known by the names of the *morning* and *evening star*, likewise keeps near the sun, though she recedes from him almost double the distance of mercury. She is never seen in the eastern quarter of the heavens when the sun is in the western; but always seems to attend him in the evening, or to give notice of his approach in the morning.

Mars is of a red fiery colour, and always gives a much duller light than Venus, though sometimes he equals her in size. He is not subject to the same limitation in his motions as Mercury or Venus; but appears sometimes very near the sun, and sometimes at a great distance from him; sometimes rising when the sun sets, or setting when he rises. Of this planet it is remarkable, that when he approaches any of the fixed stars, which all the planets frequently do, these stars change their colour, grow dim, and often become totally invisible, though at some little distance from the body of the planet: but Mr Herschel thinks this has been exaggerated by former astronomers.

Jupiter and Saturn likewise often appear at great distances from the sun. The former shines with a bright white light, and the latter with a pale faint one: and

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the motion of Saturn among the fixed stars is so slow, that, unless carefully observed, he will not be thought to move at all.

41 Apparent magnitudes of the planets different at different times.

Besides the motions which we observe in all these planets, their apparent magnitudes are very different at different times. Every person must have observed that Venus, though she constantly appears with great splendor is not always equally big; and this apparent difference of magnitude is so remarkable, that she appears no less than 32 times larger at some seasons than at others. This increase of magnitude is likewise very remarkable in Mars and Jupiter, but less so in Saturn and Mercury.

42 Their irregular motion.

Though we have thus described the motions of the planets with respect to their apparent distances from the sun, they by no means appear to us to move regularly in the heavens; but, on the contrary, in the most complex and confused manner that can be imagined, sometimes going forward, sometimes backward, and sometimes seeming to be stationary. They all seem to describe looped curves; but it is not known when any of these curves would return into themselves, except that of Venus, which returns nearly into itself every eighth year. On each side of the loops they appear stationary; in that part of each loop near the earth, retrograde; and in every other part of their path direct.

43 Comets.

These, however, are not the only moving bodies which are to be observed in the celestial regions. The six abovementioned are indeed the only ones which appear almost constantly, or disappear only at certain intervals, and then as certainly return. But there are others which appear at uncertain intervals, and with a very different aspect from the planets. These are very numerous, and no fewer than 450 are supposed to belong to our solar system. They are called *Comets*, from their having a long tail, somewhat resembling the appearance of hair. This, however, is not always the case; for some comets have appeared which were as well defined and as round as planets: but in general they have a luminous matter diffused around them, or projecting out from them, which to appearance very much resembles the Aurora Borealis. When these appear, they come in a direct line towards the sun, as if they were going to fall into his body; and after having disappeared for some time in consequence of their proximity to that luminary, they fly off again on the other side as fast as they came, projecting a tail much greater and brighter in their recess from him than when they advanced towards him; but, getting daily at a farther distance from us in the heavens, they continually lose of their splendor, and at last totally disappear. Their apparent magnitude is very different: sometimes they appear only of the bigness of the fixed stars; at other times they will equal the diameter of Venus, and sometimes even of the sun or moon. So, in 1652, Hevelius observed a comet which seemed not inferior to the moon in size, though it had not so bright a splendor, but appeared with a pale and dim light, and had a dismal aspect. These bodies will also sometimes lose their splendor suddenly, while their apparent bulk remains unaltered. With respect to their apparent motions, they have all the inequalities of the planets; sometimes seeming to go forwards, sometimes backwards, and sometimes to be stationary.

44 Fixed stars seemingly destructible and generable.

Though the fixed stars are the only marks by which astronomers are enabled to judge of the courses of the moveable ones, and though they have never been observed to change their places; yet they seem not to be endued with the permanency even of the earth and planets, but to be perishable or destructible by accident, and likewise generable by some natural cause. Several stars observed by the ancients are now no more to be seen, but are destroyed; and new ones have appeared, which were unknown to the ancients. Some of them have also disappeared for some time, and again become visible.

We are also assured from the observations of astronomers, that some stars have been observed which never were seen before, and for a certain time they have distinguished themselves by their superlative lustre; but afterwards decreasing, they vanished by degrees, and were no more to be seen. One of these stars being first seen and observed by Hipparchus, the chief of the ancient astronomers, set him upon composing a catalogue of the fixed stars, that by it posterity might learn whether any of the stars perish, and others are produced afresh.

45 Dr Halley's history of new stars.

After several ages another new star appeared to Tycho Brache and the astronomers who were cotemporary with him; which put him on the same design with Hipparchus, namely, the making a catalogue of the fixed stars. Of this, and other stars which have appeared since that time, we have the following history by Dr Halley: "The first new star in the chair of Cassiopeia, was not seen by Cornelius Gemma on the 8th of November 1572, who says, he that night considered that part of the heaven in a very serene sky, and saw it not: but that the next night, November 9, it appeared with a splendor surpassing all the fixed stars, and scarce less bright than Venus. This was not seen by Tycho Brache before the 11th of the same month: but from thence he assures us that it gradually decreased and died away, so as in March 1574, after sixteen months, to be no longer visible; and at this day no signs of it remain. The place thereof in the sphere of fixed stars, by the accurate observations of the same Tycho, was $0^s\ 9^\circ\ 17'$ *a* 1^{ma} ✱ ♈^{is}, with $53^\circ\ 45'$ north latitude.

"Such another star was seen and observed by the scholars of Kepler, to begin to appear on Sept. 30. *st. vet.* anno 1604, which was not to be seen the day before: but it broke out at once with a lustre surpassing that of Jupiter; and like the former, it died away gradually, and in much about the same time disappeared totally, there remaining no footsteps thereof in January 1605—6. This was near the ecliptic, following the right leg of Serpentarius; and by the observations of Kepler and others, was in $7^s\ 20^\circ\ 00'$ *a* 1^{ma} ✱ ♈, with north latitude $1^\circ\ 56'$. These two seem to be of a distinct species from the rest, and nothing like them has appeared since.

"But between them, viz. in the year 1596, we have the first account of the wonderful star in Collo Ceti, seen by David Fabricius on the third of August, *st. vet.* as bright as a star of the third magnitude which has been since found to appear and disappear periodically, its

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its period being preciſely enough ſeven revolutions in ſix years, though it returns not always with the ſame luſtre. Nor is it ever totally extinguiſhed, but may at all times be ſeen with a ſix-feet tube. This was ſingular in its kind, till that in Collo Cygni was diſcovered. It precedes the firſt ſtar in Aries 1° 40′, with 15° 57′ ſouth latitude.

"Another new ſtar was firſt diſcovered by William Janſonius in the year 1600, *in pectore*, or rather *in eductione*, Colli Cygni, which exceeded not the third magnitude. This having continued ſome years, became at length ſo ſmall, as to be thought by ſome to have diſappeared entirely: but in the years 1657, 1658, and 1659, it again aroſe to the third magnitude; tho' ſoon after it decayed by degrees to the fifth or ſixth magnitude, and to this day is to be ſeen as ſuch in 9^s 18° 38′ *a* 1^{ma} * ♈, with 55° 29′ north latitude.

"A fifth new ſtar was firſt ſeen by Hevelius in the year 1670, on July 15. *ſt. vet.* as a ſtar of the third magnitude, but by the beginning of October was ſcarce to be perceived by the naked eye. In April following it was again as bright as before, or rather greater than of the third magnitude, yet wholly diſappeared about the middle of Auguſt. The next year, in March 1672, it was ſeen again, but not exceeding the 6th magnitude: ſince when, it has been no further viſible, though we have frequently ſought for its return; its place is 9^s 3° 17′ *a* 1^{ma} * ♈, and has lat. north 47° 28′.

"The ſixth and laſt is that diſcovered by Mr G. Kirch in the year 1686, and its period determined to be of 404½ days; and though it rarely exceeds the fifth magnitude, yet it is very regular in its returns, as we found in the year 1714. Since then we have watched, as the abſence of the moon and clearneſs of the weather would permit, to catch the firſt beginning of its appearance in a ſix-feet tube, that, bearing a very great aperture, diſcovers moſt minute ſtars. And on June 15, laſt, it was firſt perceived like one of the very leaſt teleſcopical ſtars: but in the reſt of that month and July, it gradually increaſed, ſo as to become in Auguſt viſible to the naked eye; and ſo continued all the month of September. After that, it again died away by degrees; and on the eighth of December, at night, was ſcarce diſcernible by the tube; and, as near as could be gueſſed, equal to what it was at its firſt appearance on June 25th: ſo that this year it has been ſeen in all near ſix months, which is but little leſs than half its period; and the middle, and conſequently the greateſt brightneſs, falls about the 10th of September."

46 Mr Montanere's account of changes among the fixed ſtars.

Concerning the changes which happen among the fixed ſtars, Mr Montanere, profeſſor of mathematics at Bononia, gave the following account, in a letter to the Royal Society, dated April 30th, 1670. "There are now wanting in the heavens two ſtars of the ſecond magnitude in the ſtern of the ſhip Argo, and its yard; Bayerus marked them with the letters β and γ. I and others obſerved them in the year 1664, upon the occaſion of the comet that appeared that year: when they diſappeared firſt, I know not: only I am ſure that in the year 1668, upon the 10th of April, there was not the leaſt glimpſe of them to be ſeen; and yet the reſt about them, even of the third and fourth magnitudes, remained the ſame. I have obſerved many more changes among the fixed ſtars, even to the number of an hundred, though none of them are ſo great as thoſe I have ſhowed."

The late improvements in aſtronomy, and particularly thoſe in the conſtruction of teleſcopes, have now given aſtronomers an opportunity of obſerving the changes which take place among the ſtars with much greater accuracy than could be formerly done. In a paper in the 76th volume of the Philoſophical Tranſactions, Mr Edward Pigot gives a diſſertation on the ſtars ſuſpected by the aſtronomers of laſt century to be changeable. For the greater accuracy in the inveſtigation of his ſubject, he divides them into two claſſes; one containing thoſe which are undoubtedly changeable, and the other thoſe which are only ſuſpected to be ſo. The former contains a liſt of 12 ſtars, from the firſt to the fourth magnitudes; including the new one which appeared in Caſſiopeia in 1572, and that in Serpentarius in 1604: the other contains the names of 38 ſtars of all magnitudes, from the firſt to the ſeventh. He is of opinion, that the celebrated new ſtar in Caſſiopeia is a periodical one, and that it returns once in 150 years. Mr Keill is of the ſame opinion; and Mr Pigot thinks, that its not being obſerved at the expiration of each period is no argument againſt the truth of that opinion; "ſince (ſays he), perhaps, as with moſt of the variable, it may at different periods have different degrees of luſtre, ſo as ſometimes only to increaſe to to the ninth magnitude; and if this ſhould be the caſe, its period is probably much ſhorter." For this reaſon, in September 1782, he took a plan of the ſmall ſtars near the place where it formerly appeared, but in four years had obſerved no alteration.

47 Mr Pigot's remarks on the accounts of variable ſtars.

48 Star in Collo Celi.

The ſtar in the neck of the Whale had alſo been examined by Mr Pigot from the end of 1782 to 1786, but he never found it exceed the ſixth magnitude; though Mr Goodricke had obſerved it on the 9th of Auguſt to be of the ſecond magnitude, and on the 3d of September the ſame year it was of the third magnitude. Mr Pigot deduced its period from its apparent equality with a ſmall ſtar in the neighbourhood, and thence found it to be 320, 328, and 337 days.

49 Algol.

The moſt remarkable of theſe changeable ſtars is that called *Algol*, in the head of Meduſa. It had long been known to be variable; but its period was firſt aſcertained by Mr Goodricke of York, who began to obſerve it in the beginning of 1783. It changes continually from the firſt to the fourth magnitude; and the time taken up from its greateſt diminution to its leaſt is found, at a mean, to be 2 days 20 hours 49 minutes and 3 ſeconds. During four hours it gradually diminiſhes in luſtre, which it recovers during the ſucceeding four hours; and in the remaining part of the period it invariably preſerves its greateſt luſtre, and after the expiration of the term its diminution again commences. According to Mr Pigot, the degree of brightneſs of this ſtar when at its *minimum* is variable in different periods, and he is of the ſame opinion with regard to its brightneſs when at its full; but whether theſe differences return regularly or not, has not been determined.

The 420th of Mayer's catalogue in Leo, has lately been ſhewn to be variable by Mr. Koch. Some years before 1782, that gentleman perceived it undoubtedly ſmaller than the 419th of the ſame catalogue. In February

bruary that year, it was of the same brightness with the 419th, that is, of the seventh magnitude. In April 1783, it was of the ninth magnitude; and in the same month 1784, it was of the tenth. Mr Pigot could never observe this star, though he frequently looked for it with a night-glass, and on the fifth of April 1785 with a three-feet achromatic transit instrument.

50 Variable star in Hydra.

In 1704, Maraldi observed a variable star in Hydra, whose period he settled at about two years, though with considerable variations: but from the observations even of Maraldi, Mr Pigot concludes, that its period was then only 494 days; and from some others made by himself, he thinks that now it is only 487 days; so that since the time of Maraldi it has shortened seven days. The particulars relating to this star are as follow. 1. When at its full brightness it is of the fourth magnitude, and does not perceptibly change for a fortnight. 2. It is about six months in increasing from the tenth magnitude and returning to the same; so that it may be considered as invisible during that time. 3. It is considerably more quick, perhaps one half more so, in its increase than in its decrease. 4. Though when at its full it may always be styled a star of the fourth magnitude, it does not constantly attain the same degree of brightness, but the differences are very small. This star is the 30th of Hydra in Hevelius's catalogue, and is marked by him of the sixth magnitude.

51 Swan's head.

The new star in Serpentarius, observed by Kepler, seems to have been of the same nature with that of Cassiopeia; and Mr. Pigot therefore looks upon it also to be a periodical one, though, after taking a plan of the nearest stars in that part of the heavens, in the year 1782, he could, in four years time, perceive no alteration.

The variation of the star β Lyræ was discovered by Mr Goodricke abovementioned, who suspects its period to be six days nine hours; which coincides with the opinion of Mr Pigot.

The new star near the Swan's Head, observed by Don Anthelme in December 1669, soon became of the third magnitude, and disappeared in 1672. Mr Pigot has constantly looked for it since November 1781, but without success. He is of opinion, that had it only increased to the 10th or 11th magnitude, he would have seen it, having taken a plan of all the neighbouring small stars.

The next variable star in Mr Pigot's catalogue is the η Antinoi, whose variation and period he discovered in 1785. From his corrected observations, he concludes that it continues at its greatest brightness 40 hours without decreasing; it is 66 hours after it begins to decrease before it comes to its full diminution; after which it continues stationary for 30 hours more, and then increases for 36 hours. In every period it seems to acquire its full brightness, and to be equally decreased.

52 Swan's neck.

The variable star in the Swan's Neck was observed for three years. The period of this star had been settled by Maraldi and Cassini at 405, and by M. Le Gentil at 405.3 days; but from a mean of the observations of Mr Pigot, it appears to be only 329. "Perhaps (says he) its period is irregular; to determine which several intervals of 15 years ought to be taken; and I am much inclined to believe that it will be found only 396 days 21 hours." The particulars relating to this star are: 1. When at its full brightness it undergoes no perceptible change for a fortnight. 2. It is about three months and an half in increasing from the 11th magnitude to its full brightness, and the same in decreasing; for which reason it may be considered as invisible during six months. 3. It does not always attain the same degree of lustre, being sometimes of the fifth and sometimes of the seventh magnitude.

53 Swan's breast.

In 1600, G. Jansonius discovered a variable star in the breast of the Swan, which was afterwards observed by different astronomers, and supposed to have a period of about ten years. The results of Mr Pigot's calculations from the observations of former astronomers are, 1. That it continues in full lustre for five years. 2. It decreases rapidly for two years. 3. It is invisible to the naked eye for four years. 4. It increases slowly during seven years. 5. All these changes are completed in 18 years. 6. It was at its *minimum* at the end of the year 1663. 7. It does not always increase to the same degree of brightness, being sometimes of the third, and at others only of the sixth magnitude. "I am entirely ignorant (says Mr. Pigot) whether it is subject to the same changes in this century, having not met with any series of observations on it; but if the above conjectures are right, it will be at its minimum in a very few years. Since November 1781 I have constantly seen it of the sixth magnitude. Sometimes I have suspected that it has decreased within these two last years, though in a very small degree."

The last star in Mr. Pigot's first class is the δ Cephei, whose variation was discovered by Mr. Goodricke. Its changes are very difficult to be seen, unless it is observed at the times of its greatest and least brightness. The result of the observations hitherto made upon it are, that its period consists of 5 days 8 hours 37′ on a mean. The following observations relate to some stars of the second class.

54 Stars, the variation of which is less certain.

1. Hevelius's 6th Cassiopeæ was missing in 1782, nor could Mr Pigot find it in 1783 and 1784.

2. ξ or 46th Andromedæ, said to be variable, but the evidence is not convincing to Mr Pigot.

3. Flamstead's 50, 52, Andromedæ, and Hevelius's 41 Andromedæ. The position and characters of these stars differ considerably in different catalogues, and some of them are said by Cassini to have disappeared and reappeared. Mr Pigot therefore gives their comparative brightness as observed in the years 1783, 1784, and 1785, during which time he does not mention any particular change.

4. Tycho's 20th Cœti. "This (says Mr Pigot) must be the star which Hevelius said had disappeared, being Tycho's second in the Whale's Belly. There can hardly be any doubt that it is the χ, misplaced by Tycho. This χ is of the fourth or fifth magnitude."

5. σ, or the 17th Eridani of Ptolemy and Ulug Beigh. Flamstead says he could not see this star in 1691 and 1692; but in 1782, 1783, and 1784, Mr Pigot observed in that place one of the seventh magnitude, which appeared always of the same lustre.

6. Flamstead's 41 Tauri was supposed by Cassini to be either a new or variable star; but Mr Pigot thinks there is no reason to be of that opinion. "That it is not

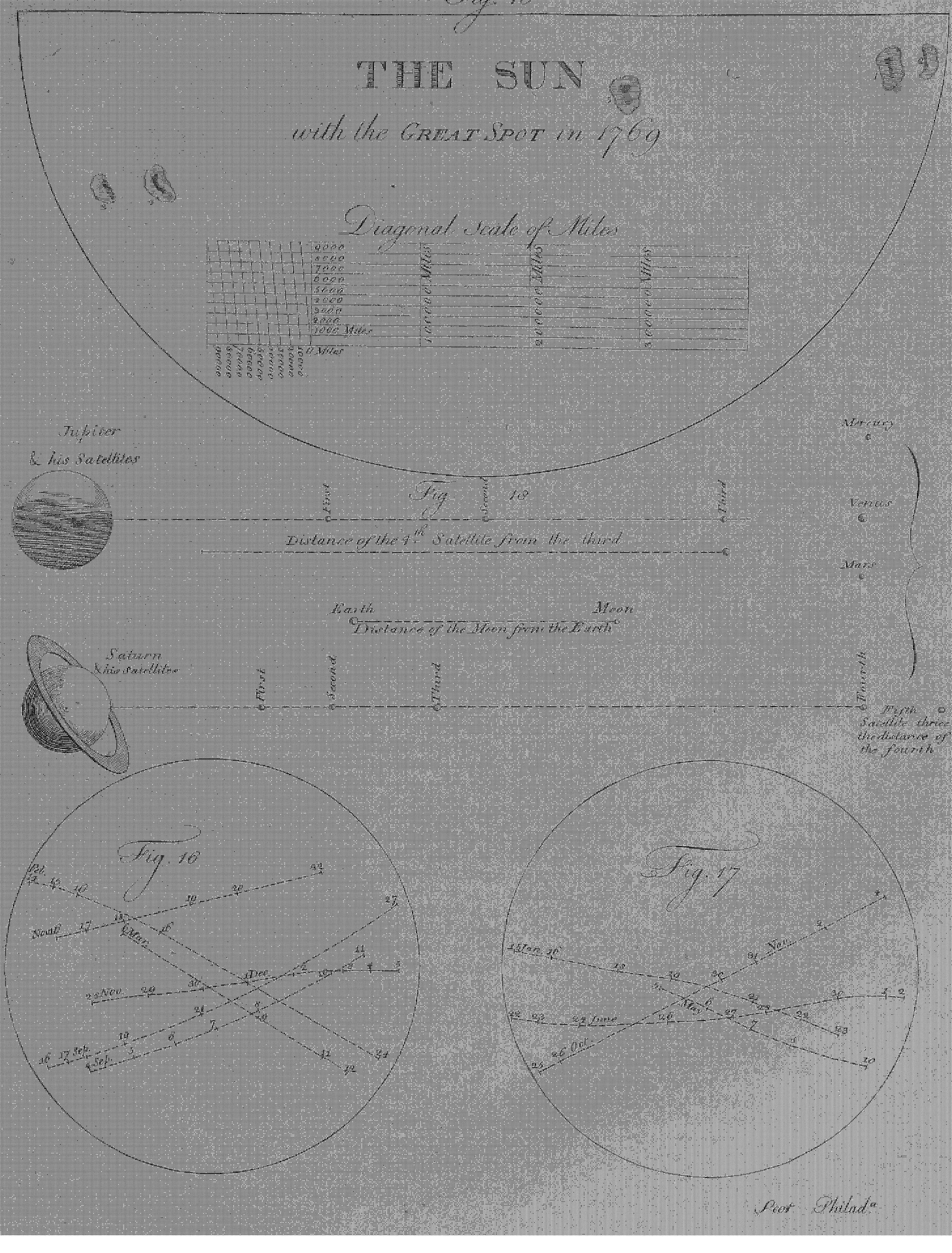
Fig. 15
THE SUN
with the GREAT SPOT in 1769
Diagonal Scale of Miles
1000 Miles
0 Miles
100000 Miles
200000 Miles
300000 Miles
Jupiter
& his Satellites
First
Fig 18
Second
Third
Distance of the 4th Satellite from the third
Mercury
Venus
Mars
Earth
Moon
Distance of the Moon from the Earth
Saturn
& his Satellites
First
Second
Third
Fourth
Fifth Satellite thrice the distance of the fourth
Fig. 16
Fig. 17
Scot Philad.a

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not new (ſays he) is evident, ſince it is Ulug Beigh's 26th and Tycho's 43d.

7. A ſtar about 2½ north of 53 Eridani, and 47 Eridani. Caſſini ſuppoſed the firſt of theſe ſtars to be a new one, and that it was not viſible in 1664. He mentions another ſtar thereabouts, which he alſo eſteemed a new one.

8. γ Canis Majoris. Maraldi could not ſee this ſtar in 1670; but in 1692 and 1693 it appeared of the fourth magnitude. Mr Pigot made frequent obſervations upon it from 1782 to 1786, but could perceive no variation.

9. α, β Geminorum. "If either of theſe ſtars (ſays our author) have changed in brightneſs, it is probable the β. In 1783, 1784, and 1785, the β was undoubtedly brighter than α."

10. ξ Leonis. According to Montanari, this ſtar was hardly viſible in 1693. In 1783, 1784, and 1785, it was of the fifth magnitude. By Tycho, Flamſtead, Mayer, Bradley, &c. it is marked of the fourth.

11. ψ Leonis. This ſtar is ſaid to have diſappeared before the year 1667, but according to Mr Pigot's obſervations, was conſtantly of the fifth or ſixth magnitude ſince 1783.

12. 25th Leonis. In 1783 our author firſt perceived that this ſtar was miſſing, and could not perceive it in 1784 and 1785, even with a tranſit inſtrument.

13. Bayer's *i* Leonis, or Tycho's 16 Leonis, was not viſible in 1709, nor could it be ſeen in 1785. It is a different ſtar from the *i* Leonis of the other catalogues, though Tycho's deſcription of its place is the ſame.

14. δ Urſæ Majoris. This ſtar is ſuſpected to change in brightneſs, on account of its being marked by Tycho, the prince of Heſſe, &c. of the ſecond magnitude, while Hevelius, Bradley and others have marked it of the third. In 1786, and for three years before it appeared as a bright ſtar of the fourth magnitude.

15. η Virginis. This is ſuppoſed to be variable, becauſe Flamſtead, on the 27th of January 1680, could not ſee it; but he obſerved it in 1677, and ſome years afterwards. Mr Pigot obſerved it frequently in 1784 and 1785, and found it a ſtar of the ſixth magnitude without any perceptible change.

16. Bayer's ſtar of the ſixth magnitude 1° ſouth of *g* Virginis. "This ſtar (ſays Mr Pigot) is not in any of the nine catalogues that I have. Maraldi looked for it in vain; and in May 1785 I could not ſee the leaſt appearance of it. It certainly was not of the eighth magnitude.

17. A ſtar in the northern thigh of Virgo, marked by Ricciolus of the ſixth magnitude, could not be ſeen by Maraldi in 1709: nor was it of the ninth magnitude, if at all viſible in 1785.

18. The 91 and 92 Virginis. In 1785, one of theſe ſtars, probably the 91, was miſſing; the remaining one is of the ſixth or ſeventh magnitude.

19. α Draconis. Mr Pigot coincides in opinion with Mr Herſchel, that this ſtar is variable. Bradley, Flamſtead, &c. mark it of the ſecond magnitude, but in 1786 it was only a bright fourth. It was frequently examined by Mr Pigot from the 4th of October 1782, but without any alteration being perceived.

20. Bayer's ſtar in the weſt ſcale of Libra. Maraldi could not ſee this ſtar, and it was likewiſe inviſible to Mr Pigot in 1784 and 1785.

21. N° 6 of Ptolemy and Ulug Beigh's unformed in Libra. This ſtar is not mentioned in any other catalogues than the above. Mr Pigot frequently obſerved a little ſtar of the ſeventh magnitude very near its place.

22. κ Libræ. This ſtar is thought to be variable; but Mr Pigot is not of that opinion, though "certainly (ſays he) it is rather ſingular, that Hevelius, whoſe attention was directed to that part of the heavens to find Tycho's 11th, did not find the κ; and the more ſo, as he has noticed two much ſmaller ſtars not far from it. During theſe three years I have found the κ conſtantly of the fifth magnitude."

23. Tycho's 11th Libræ. Mr Pigot is of opinion that no ſuch ſtar as this ever exiſted; and that it is no other than the κ with an error of 2 degrees of longitude.

24. 33 Serpentis. This ſtar was miſſing in 1784; nor could it be perceived with a night-glaſs in 1785.

25. A ſtar marked by Bayer near ε urſæ majoris. This ſtar could not be ſeen by Caſſini; nor was Mr Pigot able to diſcover it with a night-glaſs in 1782.

26. The ρ, or Ptolemy and Ulug Beigh's 14th Ophiuchi, or Flamſtead's 36th. Mr Pigot has no doubt that this is the ſtar which is ſaid to have diſappeared before the year 1695; and it is evident that it was not ſeen by Hevelius. In 1784 and 1785 Mr Pigot found it of the fourth or fifth magnitude: but he is far from being certain of its having undergone any change, eſpecially as it has a ſouthern declination of 26 degrees; for which reaſon great attention muſt be paid to the ſtate of the atmoſphere.

27. Ptolemy's 13th and 18th Ophiuchi, fourth magnitude. Mr Pigot is of opinion that theſe ſtars are miſplaced in the catalogues. The 18th of Ptolemy he thinks ought to be marked with a north latitude inſtead of a ſouth, which would make it agree nearly with Flamſtead's 58th; and he is alſo of opinion that the 13th of Ptolemy is the 40th of Flamſtead.

28. σ Sagittarii. Mr Herſchel, as well as Mr Pigot, is of opinion, that this ſtar has probably changed its magnitude, though the reaſon ſeems only to be the great diſagreement concerning it among the different catalogues of ſtars.

29. θ Serpentis. This ſtar, according to Mr Montanari, is of variable magnitude; but Mr Pigot never could perceive any alteration.

30. Tycho's 27th Capricorni was miſſing in Hevelius's time, and Mr Pigot could not find it with a tranſit inſtrument.

31. Tycho's 22d Andromedæ, and ο Andromedæ. Mr Caſſini informs us, that in his time the former had grown ſo ſmall that it could ſcarcely be ſeen; and Mr Pigot, that no ſtar was to be ſeen its place in 1784 and 1785: but he is of opinion that Caſſini may have miſtaken the ο Andromedæ for the 22d; for which reaſon he obſerved this ſtar three years, but without any alteration in its brightneſs.

32. Tycho's 19th Aquarii. Hevelius ſays that this ſtar was miſſing, and that Flamſtead could not ſee it with his naked eye in 1679. Mr Pigot could not ſee it in 1782; but is perſuaded that it is the ſame with Flamſtead's

Apparent Motion, &c.

Flamſtead's 56th marked *f* by Bayer, from which it is only a degree and an half diſtant. The 53d of Flamſtead, marked *f* in Ptolemy's catalogue, is a different ſtar.

33. La Caille's 483 Aquarii was firſt diſcovered to be miſſing in 1778, and was not viſible in 1783 and 1784.

Beſides theſe there are ſeveral others certainly variable, but which cannot be ſeen in this country. There are ſome alſo ſuſpected to be variable, but for which Mr Pigot thinks there is no reaſon. Mr Herſchel alſo gives ſtrong reaſons for not laying great ſtreſs on all the obſervations by which new ſtars have been ſaid to be diſcovered. Mr Pigot aſſures us from repeated experience, that even more than a ſingle obſervation, if not particulariſed and compared with neighbouring ſtars, is very little to be depended upon; different ſtreaks of the clouds, the ſtate of the weather, &c. having often cauſed him to err a whole magnitude in the brightneſs of the ſtar.

55 Wollaſton's method of diſcovering variations among the fixed ſtars.

As theſe changes to which the fixed ſtars are liable do not ſeem to be ſubject to any certain rule, Mr Wollaſton has given an eaſy method of obſerving whether they do take place in any part of the heavens or not, and that without much expence of inſtruments or waſte of time, which are great objections to aſtronomical obſervations in general. His firſt idea was, that the work ſhould be undertaken by aſtronomers in general; each taking a particular diſtrict of the heavens, and from time to time obſerving the right aſcenſion and declination of every ſtar in that ſpace allotted to him, framing an exact map of it, and communicating their obſervations to one common place of information. This method, however, being too laborious, he next propoſes the noting down at the time, or making a drawing of what one ſees while they are obſerving. A drawing of this kind once made, would remain, and could be conſulted on any future occaſion; and if done at firſt with care, a tranſient review would diſcover whether any ſenſible change had taken place ſince it was laſt examined, which could not ſo well be done by catalogues or verbal deſcription. For this purpoſe he recommends the following method: "To a night-glaſs, but of Dollond's conſtruction, which magnifies about ſix times, and takes in about as many degrees of a great circle, I have added croſs wires interſecting one another at an angle of 45 degrees. More wires may be croſſed in other directions; but I apprehend theſe will be ſufficient. This teleſcope I mount on a polar axis. One coarſely made, and without any diviſions on its circle of declination, will anſwer the purpoſe, as there is no great occaſion for accuracy in that reſpect; but as the heavenly bodies are more readily followed by an equatorial motion of the teleſcope, ſo their relative poſitions are much more eaſily diſcerned when they are looked at conſtantly as in the ſame direction. An horizontal motion, except in the meridian, would be apt to miſlead the judgment. It is ſcarcely neceſſary to add, that the wires muſt ſtand ſo as for one to deſcribe a parrallel of the equator nearly; another will then be a horary circle, and the whole area will be divided into eight equal ſectors.

"Thus prepared, the teleſcope is to be pointed to a known ſtar, which is to be brought into the centre or common interſection of all the wires. The relative poſitions of ſuch other ſtars as appear within the field are to be judged of by the eye; whether at $\frac{1}{2}$, $\frac{1}{3}$, or $\frac{1}{4}$ from the centre towards the circumference, or *vice verſa*; and ſo with regard to the neareſt wire reſpectively. Theſe, as one ſees them, are to be noted down with a black-lead pencil upon a large meſſage-card held in the hand, upon which a circle ſimilarly divided is ready drawn. One of three inches diameter ſeems moſt convenient. The motion of the heavenly bodies in ſuch a teleſcope is ſo ſlow, and the noting down of the ſtars ſo quickly done, that there is commonly full time for it without moving the teleſcope. When that is wanted, the principal ſtar is eaſily brought back again into the centre of the field at pleaſure, and the work reſumed. After a little practice, it is aſtoniſhing how near one can come to the truth in this way: and tho' neither the right aſcenſions nor the declinations are laid down by it, nor the diſtances between the ſtars meaſured; yet their apparent ſituations being preſerved in black and white, with the day and year, and hour, if thought neceſſary, written underneath, each card then becomes a regiſter of the then appearance of the heavens; which is eaſily re-examined at any time with little more than a tranſient view; and which will yet ſhow, on the firſt glance, if there ſhould have happened in it any alteration of conſequence."

Plate LXVI.

Fig. 35. ſhows part of the corona borealis delineated in this manner, and which was afterwards fully taken down by making the ſtars α, β, γ, δ, ϵ, ζ, ϑ, ι, κ, π, ρ, σ, and τ ſucceſſively central; and theſe were joined with ſome of the ſtars of Bootes, for the ſake of connecting the whole, and united into one map, as repreſented fig. 37.

In obſerving in this way, it is evident, that the places of ſuch ſtars as happen to be under or very near any of the wires are more to be depended upon than thoſe which are in the intermediate ſpaces, eſpecially if towards the edges of the fields; ſo alſo thoſe which are neareſt to the centre, becauſe better defined, and more within the reach of one wire or another. For this reaſon, different ſtars of the ſame ſet muſt ſucceſſively be made central, or brought towards one of the wires, where any ſuſpicion ariſes of a miſtake, in order to approach nearer to a certainty; but if the ſtand of the teleſcope be tolerably well adjuſted and fixed, this is ſoon done.

In ſuch a glaſs it is ſeldom that light ſufficient for diſcerning the wires is wanting. When an illuminator is required, a piece of card or white paſteboard projecting on one ſide beyond the tube, and which may be brought forward occaſionally, is better than any other. By cutting acroſs a ſmall ſegment of the object-glaſs, it throws a ſufficient light down the tube though the candle be at a great diſtance, and one may loſe ſight of the falſe glare by drawing back the head, and moving the eye a little to one ſide, when the ſmall ſtars will be ſeen as if no illuminator was there. See a delineation of the principal fixed ſtars, with the apparent path of the ſun among them, on plate LXIV. and LXV.

56 Galaxy, or milky-way.

A very remarkable appearance in the heavens is that called the *galaxy*, or *milky-way*. This is a broad circle, in ſome places double, but for the moſt part ſingle, ſurrounding the whole celeſtial concave. It is of a whitiſh colour, ſomewhat reſembling a faint aurora borealis; but Mr Brydone, in his journey to the top of mount Ætna, found that phenomenon to make a glorious appearance

ASTRONOMY

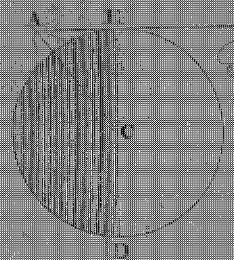

Fig 20

Fig 21
1773 h. 8. 55
2 3. at
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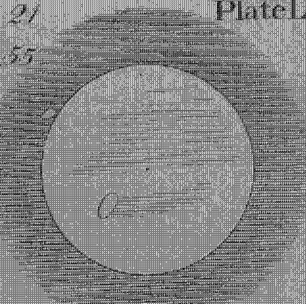


Fig 19
The Moon in her mean libration
with the Spots according to Riccioli Cassini &c

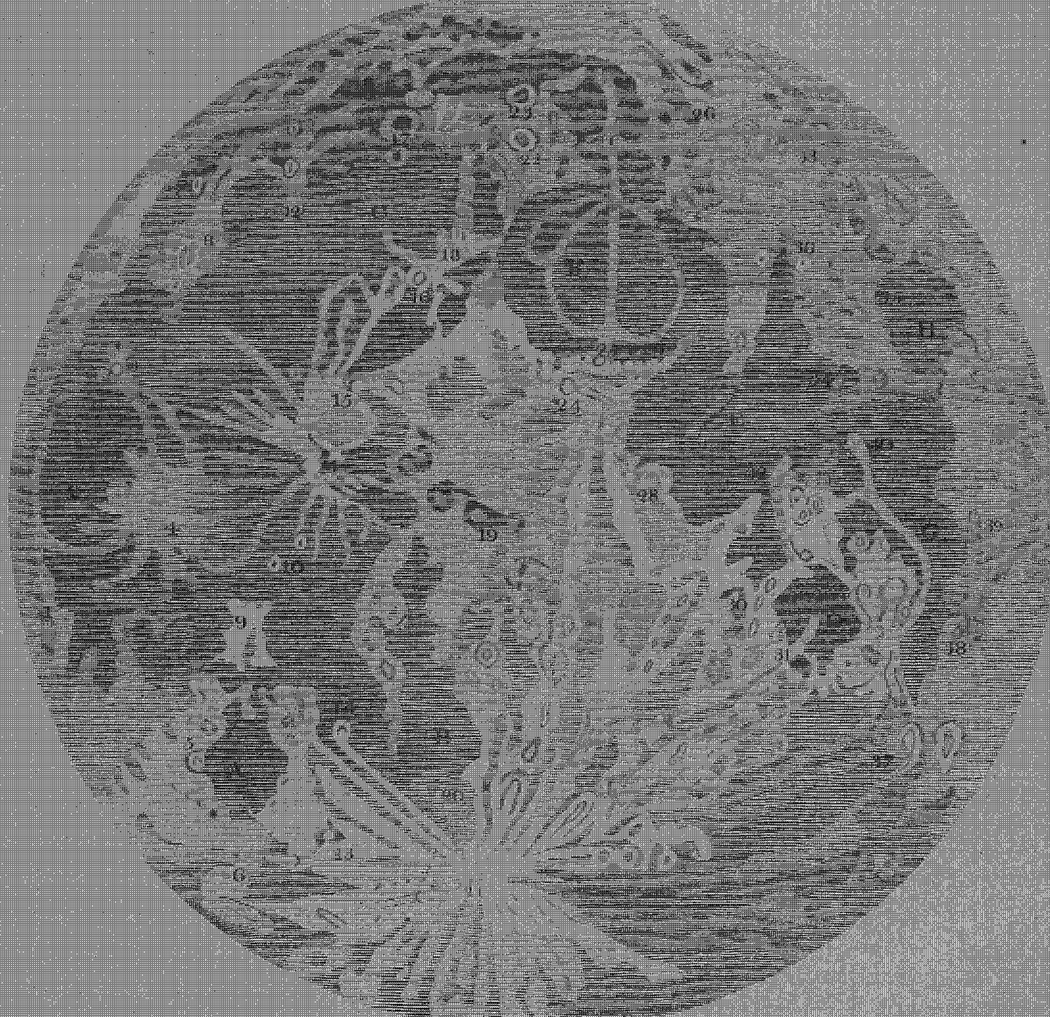
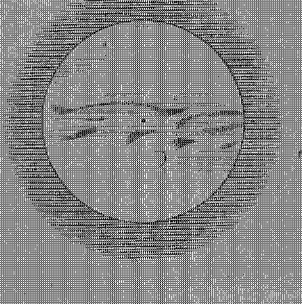
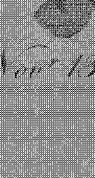


Fig 22



Sept. 15
H 9. 0

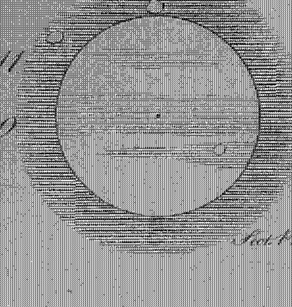
Fig 23



Nov. 13 1773

Fig 22

Sept. 11
H 9. 0



Scot Philad.

Appearances of Celestial Bodies thro' Telescopes.

pearance, being, as he expresses it, like a pure flame that shot across the heavens.

The only appearance, besides those already mentioned, which are very observable by the unassisted eye, are those unexpected obscurations of the sun and moon, commonly called *eclipses*. These are too well known, and attract the attention too much, to need any particular description. We have, however, accounts very well authenticated, of obscurations of the sun continuing for a much longer time than a common eclipse possibly can do, and likewise of the darkness being much greater than it usually is on such occasions: and that these accounts are probably true, we shall afterwards have occasion to observe.

57 Eclipses.

Sect. II. *Of the Appearances of the Celestial Bodies as seen through Telescopes.*

1. The sun, tho' to human eyes so extremely bright and splendid, is yet frequently observed, even through a telescope of but very small powers, to have dark spots on his surface. These were entirely unknown before the invention of telescopes, though they are sometimes of sufficient magnitude to be discerned by the naked eye, only looking through a smoked glass to prevent the brightness of the luminary from destroying the sight. The spots are said to have been first discovered in the year 1611; and the honour of the discovery is disputed betwixt Galileo and Scheiner, a German Jesuit at Ingoldstadt. But whatever merit Scheiner might have in the priority of the discovery, it is certain that Galileo far exceeded him in accuracy, though the work of Scheiner has considerable merit, as containing observations selected from above 3000, made by himself. Since his time the subject has been carefully studied by all the astronomers in Europe; the result of whose observations, as given by Dr Long, is to the following purpose.

58 Solar spots when first discovered.

59 Dr Long's account of them.

There is great variety in the magnitudes of the solar spots; the difference is chiefly in superficial extent of length and breadth; their depth or thickness is very small: some have been so large, as by computation to be capable of covering the continents of Asia and Africa; nay, the whole surface of the earth, or even five times its surface. The diameter of a spot, when near the middle of the disk, is measured by comparing the time it takes in passing over a cross hair in a telescope, with the time wherein the whole disk of the sun passes over the same hair; it may also be measured by the micrometer; and by either of these methods we may judge how many times the diameter of the spot is contained in the diameter of the sun. Spots are subject to increase and diminution of magnitude, and seldom continue long in the same state. They are of various shapes; most of them having a deep black nucleus surrounded by a dusky cloud, whereof the inner parts near the black are a little brighter than the outskirts. They change their shapes, something in the manner that our clouds do; though not often so suddenly: thus, what is of a certain figure to-day, shall, to-morrow, or perhaps in a few hours, be of a different one; what is now but one spot, shall in a little time be broken into two or three; and sometimes two or three spots shall coalesce, and be united into one. Dr Long, many years since, while he was viewing the image of the sun through a telescope cast upon white paper, saw one roundish spot, by estimation not much less than the diameter of our earth, break into two, which receded from one another with prodigious velocity. This observation was singular at the time; for though several writers had taken notice of this after it was done, none of them had been making any observation at the time it was actually doing.

The number of spots on the sun is very uncertain; sometimes there are a great many, sometimes very few; and sometimes none at all. Scheiner made observations on the sun from 1611 to 1629; and says he never found his disk quite free of spots, excepting a few days in December 1624. At other times he frequently saw 20, 30, and in the year 1625 he was able to count 50 spots on the sun at a time. In an interval afterwards of 20 years, from 1650 to 1670, scarce any spots were to be seen, and since that time some years have furnished a great number of spots, and others none at all; but since the beginning of the last century, not a year passed wherein some were not seen; and at present, says Mr Cassini, in his *Elemens d'Astronomie* published in 1740, they are so frequent, that the sun is seldom without spots, and often shows a good number of them at a time.

From these phenomena, it is evident, that the spots are not endowed with any permanency, nor are they at all regular in their shape, magnitude, number, or in the time of their appearance or continuance. Hevelius observed one that arose and vanished in 16 or 17 hours; nor has any been observed to continue longer than 70 days, which was the duration of one in the year 1676: those spots that are formed gradually, are gradually dissolved; while those that arise suddenly, are for the most part suddenly dissolved. When a spot disappears, that part where it was generally becomes brighter than the rest of the sun, and continues so for several days; on the other hand, those bright parts (called *faculæ*, as the others are called *maculæ*) sometimes turn to spots. 60

The solar spots move from west to east.

The solar spots appear to have a motion which carries them across the sun's disk. Every spot, if it continues long enough without being dissolved, appears to enter the sun's disk on the east side, to go from thence with a velocity continually increasing till it has gone half its way; and then to move slower and slower, till it goes off at the west side, after which it disappears for about the same space of time that it spent in crossing the disk, and then enters upon the east side again, nearly in the same place, and crosses it in the same tract, and with the same unequal motion as before. This apparent inequality in the motion of the spots is purely optical, and is in such proportion as demonstrates them to be carried round equably or in a circle, the plane of which continued passes through or near the eye of a spectator upon the earth.

Besides the real changes of the spots already mentioned, there is another which is purely optical, and is owing to their being seen on a globe differently turned towards us. If we imagine the globe of the sun to have a number of circles drawn upon its surface, all passing through the poles, and cutting his equator at equal distances, these circles which we may call meridians, if they were visible, would appear to us at unequal distances, as in fig. 2. Now, suppose a spot were round, and so large as to reach from one meridian to another, it would appear round only at *g*, when it was in the middle of that half of the globe which is towards

Plate LX.

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wards our earth; for then we view the full extent of it in length and breadth: in every other place it turns away from us, and appears narrower, though of the same length, the farther it is from the middle; and on its coming on at *a*, and going off at *n*, it appears as small as a thread, the thin edge being then all that we see.

The motion of the spots is in the order of the signs (the same way that all motions in the solar system, those of the comets alone excepted, are performed); and therefore, as the earth revolves round the sun the same way with the solar spots, one of these will appear to remain longer on the disk than it would otherwise do if the earth remained at rest. Thus, in fig. 3. let A B C D be the orbit of the earth, *a b c d* the equator of the sun; let *a* be a spot seen in the middle of the disk by a spectator upon the earth at A. The spot being carried round through *b c d*, according to the order of the letters, will in about 25 days bring it again to *a*: but during that interval, the earth will be got to B, and the middle of the disk at *b*; so that about two days more will intervene before a spectator upon the earth at C will view it in the middle of the then apparent disk at *c*. There are, however, but few instances of such returning spots; so that Scheiner, out of his multitude of observations, found only three or four of this kind.

Plate LX.

As fig. 2. is an orthographic projection of meridians on the sun's disk, it may be thought that they would show the apparent diurnal motion of the spots; so that, for example, a spot which to-day at noon is in the meridian marked *a*, would to-morrow at noon be in that marked *b*, the next day in that marked *c*, and so on: but Scheiner says, that, casting the sun's picture on paper through a telescope, the distance between the place of a spot at noon any given day and the place at noon the day immediately preceding, or the day immediately following, will be greater when the spot is near the circumference of the disk than according to the orthographic projection it ought to be. This deviation of spots he thought owing to the refraction of the glasses in the telescope being greater near the circumference than in the middle; and he was confirmed in this opinion, by finding, that if spots were observed by letting the sun shine through a small hole without a glass, upon white paper held at a good distance from the hole in a dark room, their places would then be every day according to the orthographic projection. But he found this method of observing the solar spots attended with great difficulties. Another proof that this deviation of the solar spots is occasioned by the different refraction of the glasses of the telescope, is deduced from the following experiment. Our author pierced with a needle 12 small holes at equal distances in a thin plate of brass; and placing the plate before the glasses of a short telescope, let the sun shine through, receiving 12 bright spots upon a white paper placed in such a manner that the light might fall perpendicularly upon it. Here also he found the distances between the spots near the outside greater than between those in the middle; whereas, when he received them upon paper without any glasses, the situation of the bright spots exactly corresponded to that of the small holes in the plate.

The face of the sun, when clear of spots, seen by the naked eye through a smoked or coloured glass, or through a thin cloud, or the vapours near the horizon, appears all over equally luminous: but when viewed thro' the telescope, the glasses being smoked or coloured, besides the difference between the faculæ and the other parts, the middle of the disk appears brighter than the outskirts; because the light is darted more directly towards us from the middle than from any other part, and the faculæ appear more distinctly near the sides, as being on a darker ground than in the middle.

61 Account of their phenomena by different observers.

The phenomena of the solar spots, as delivered by Scheiner and Hevelius, may be summed up in the following particulars. 1. Every spot which hath a nucleus, or considerably dark part, hath also an umbra, or fainter shade, surrounding it. 2. The boundary betwixt the nucleus and umbra is always distinct and well defined. 3. The increase of a spot is gradual, the breadth of the nucleus and umbra dilating at the same time. 4. In like manner, the decrease of a spot is gradual, the breadth of the nucleus and umbra contracting at the same time. 5. The exterior boundary of the umbra never consists of sharp angles; but is always curvilinear, how irregular soever the outline of the nucleus may be. 6. The nucleus of a spot, whilst on the decrease, often changes its figure by the umbræ encroaching irregularly upon it, insomuch that in a small space of time new encroachments are discernible, whereby the boundary betwixt the nucleus and umbra is perpetually varying. 7. It often happens, by these encroachments, that the nucleus of a spot is divided into two or more nuclei. 8. The nuclei of the spots vanish sooner than the umbra. 9. Small umbræ are often seen without nuclei. 10. An umbra of any considerable size is seldom seen without a nucleus in the middle of it. 11. When a spot which consisted of a nucleus and umbra is about to disappear, if it is not succeeded by a *facula*, or spot brighter than the rest of the disk, the place where it was is soon after not distinguished from the rest.

In the Philosophical Transanctions, Vol. LXIV. Dr Wilson, professor of astronomy at Glasgow, hath given a dissertation on the nature of the solar spots, and mentions the following appearances. 1. When the spot is about to disappear on the western edge of the sun's limb, the eastern part of the umbra first contracts, then vanishes, the nucleus and western part of the umbra remaining; then the nucleus gradually contracts and vanishes, while the western part of the umbra remains. At last this disappears also; and if the spot remains long enough to become again visible, the eastern part of the umbra first becomes visible, then the nucleus; and when the spot approaches the middle of the disk, the nucleus appears environed by the umbra on all sides, as already mentioned. 2. When two spots lie very near to one another, the umbra is deficient on that side which lies next the other spot: and this will be the case, though a large spot should be contiguous to one much smaller; the umbra of the large spot will be totally wanting on that side next the small one. If there are little spots on each side of the large one, the umbra does not tototally vanish; but appears flattened, or pressed in towards the nucleus on each side. When the little spots disappear, the umbra of the large one extends itself as usual. This circumstance, he observes, may sometimes prevent the disappearance of the umbra in the manner above-

Appearances of Celestial Bodies thro' Telescopes.

abovementioned; ſo that the weſtern umbra may diſappear before the nucleus, if a ſmall ſpot happens to break out on that ſide.

In the ſame volume, p. 337. Mr Wollaſton obſerves, that the appearances mentioned by Dr Wilſon are not conſtant. He poſitively affirms, that the faculæ or bright ſpots on the ſun are often converted into dark ones. "I have many times (ſays he) obſerved, near the eaſtern limb, a bright facula juſt come on, which has the next day ſhown itſelf as a ſpot, though I do not recollect to have ſeen ſuch a facula near the weſtern one after a ſpot's diſappearance. Yet, I believe, both theſe circumſtances have been obſerved by others; and perhaps not only near the limbs. The circumſtance of the faculæ being converted into ſpots I think I may be ſure of. That there is generally (perhaps always) a mottled appearance over the face of the ſun, when carefully attended to, I think I may be as certain. It is moſt viſible towards the limbs, but I have undoubtedly ſeen it in the centre; yet I do not recollect to have obſerved this appearance, or indeed any ſpots towards his poles. Once I ſaw with a twelve-inch reflector, a ſpot burſt to pieces while I was looking at it. I could not expect ſuch an event, and therefore cannot be certain of the exact particulars; but the appearance, as it ſtruck me at the time, was like that of a piece of ice when daſhed on a frozen pond, which breaks to pieces and ſlides in various directions." He alſo acquaints us, that the nuclei of the ſpots are not always in the middle of the umbræ; and gives the figure of one ſeen November 13th 1773, which is a remarkable inſtance to the contrary. Mr Dunn, however, in his new Atlas of the Mundane Syſtem, gives ſome particulars very different from the above. "The face of the ſun (ſays he) has frequently many large black ſpots, of various forms and dimenſions, which move from eaſt to weſt, and round the ſun, according to ſome obſervations in 25 days, according to others in 26, and according to ſome in 27 days. The black or central part of each ſpot is in the middle of a great number of very ſmall ones, which permit the light to paſs between them. The ſmall ſpots are ſcarce ever in contact with the central ones: but what is moſt remarkable when the whole ſpot is near the limb of the ſun, the ſurrounding ſmall ones form nearly a ſtraight line, and the central part projects a little over it, like Saturn in his ring."

62 Mr Dunn's account.

The ſpots are by no means confined to one part of the ſun's diſk; though we have not heard of any being obſerved about his polar regions; and though their direction is from eaſt to weſt, yet the paths they deſcribe in their courſe over the diſk are exceedingly different; ſometimes being ſtraight lines, ſometimes curves, ſometimes deſcending from the northern to the ſouthern part of the diſk, ſometimes aſcending from the ſouthern to the northern, &c. This was obſerved by Mr Derham (Philoſ. Tranſ. Nº 330), who hath given figures of the apparent paths of many different ſpots, wherein the months in which they appeared, and their particular progreſs each day, are marked.

63 Mercury and Venus ſometimes appear as ſpots.

Beſides theſe ſpots, there are others which ſometimes appear very round and black, travelling over the diſk of the ſun in a few hours. They are totally unlike the others, and will be ſhown to proceed from an interpoſition of the planets Mercury and Venus between the earth and the ſun. Excepting the two kinds of ſpots abovementioned, however, no kind of object is diſcovered on the ſurface of the ſun, but he appears like an immenſe ocean of elementary fire or light.

63 Teleſcopic view of the moon.

2. With the moon the caſe is very different. Many darkiſh ſpots appear in her to the naked eye; and, through a teleſcope, their number is prodigiouſly increaſed: ſhe alſo appears very plainly to be more protuberant in the middle than at the edges, or to have the figure of a globe, and not a flat circle. When the moon is horned or gibbous, the one ſide appears very ragged and uneven, but the other always exactly defined and circular. The ſpots in the moon always keep their places exactly; never vaniſhing, or going from one ſide to the other, as thoſe of the ſun do. We ſometimes ſee more or leſs of the northern and ſouthern, and eaſtern and weſtern part of the diſk or face; but this is owing to what is called her libration, and will hereafter be explained.

The aſtronomers Florentius, Langrenus, John Hevelius of Dantzick, Grimaldus, Ricciolus, Caſſini, and M. de la Hire, have drawn the face of the moon as ſhe is ſeen through teleſcopes magnifying between 200 and 300 times. Particular care has been taken to note all the ſhining parts in her ſurface; and, for the better diſtinguiſhing them, each has been marked with a proper name. Langrenus and Ricciolus have divided the lunar regions among the philoſophers, aſtronomers, and other eminent men; but Hevelius and others, fearing leſt the philoſophers ſhould quarrel about the diviſion of their lands, have endeavoured to ſpoil them of their property, by giving the names belonging to different countries, iſlands, and ſeas on earth, to different parts of the moon's ſurface, without regard to ſituation or figure. The names adopted by Riccioli, however, are thoſe which are generally followed, as the names of *Hipparchus Tycho, Copernicus*, &c. are more pleaſing to aſtronomers than thoſe of Africa, the Mediterranean Sea, Sicily, and Mount Ætna. On Plate LXIII. is a tolerably exact repreſentation of the full moon in her mean libration, with the numbers to the principal ſpots according to Riccioli, Caſſini, Mayer, &c. The aſteriſk refers to one of the volcanoes diſcovered by Dr Herſchel, to be afterwards more particularly noticed. The names are as follow:

* Herſchel's Volcano.	20 Pitatus.
1 Grimaldus.	21 Tycho.
2 Galileus.	22 Eudoxus.
3 Ariſtarchus.	23 Ariſtoteles.
4 Keplerus.	24 Manilius.
5 Gaſſendus	25 Menelaus.
6 Shikardus.	26 Hermes.
7 Harpalus.	27 Poſſidonius.
8 Heraclides.	28 Dionyſius.
9 Lanſbergius.	29 Plinius.
10 Reinoldus.	30 { Calharina Cyrillus. / Theophilus. }
11 Copernicus	
12 Helicon.	31 Fracaſtorius.
13 Capuanus.	32 { Promontorium acutum / Cenſorinus. }
14 Bullialdus.	
15 Eratoſthenes.	33 Meſſala.
16 Timocharis.	34 Promontorium ſomnii.
17 Plato.	35 Proclus.
18 Archimedes.	36 Cleomedes.
19 Inſula Sinus Medii.	37 Snellius et Furnerius.

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38 Petavius.
39 Langrenus
40 Taruntius.
A Mare Humorum.
B Mare Nubium.
C Mare Imbrium.
D Mare Nectaris.
E Mare Tranquilitatis.
F Mare Serenitatis.
G Mare Fœcunditatis.
H Mare Crisium.

We have already observed, that when the planet Mars approaches any of the fixed stars, they lose their light, and sometimes totally disappear before he seems to touch them: but it is not so with the moon; for though she very often comes in betwixt us and the stars, they preserve their lustre till immediately in seeming contact with her, when they suddenly disappear, and as suddenly re-appear on the opposite side. When Saturn, however, was hid by the moon in June 1762, Mr. Dunn, who watched his appearance at the emersion, observed a kind of faint shadow to follow him for a little from the edge of the moon's disk. This appearance is represented fig. 88.

Plate LXIX.

64 Mercury appears always equally luminous.

3. Mercury, when looked at through telescopes magnifying about 200 or 300 times, appears equally luminous throughout his whole surface, without the least dark spot. He appears indeed to have the same difference of phases with the moon, being sometimes horned, sometimes gibbous, and sometimes shining almost with a round face, though not entirely full, because his enlightened side is never turned directly towards us, unless when so near the sun as to be invisible; but at all times perfectly well defined without any ragged edge, and perfectly bright.

65 Spots, when first discovered on the disk of Venus.

4. Dr Long informs us, that the earliest account he had met with of any spots seen by means of the telescope on the disk of Venus was in a collection of letters printed at Paris in 1665, in one of which M. Auzout relates his having received advice from Poland that Mr Burratini had, by means of large telescopes, seen spots upon the planet Venus similar to those upon the moon.

66 Cassini's observations.

In 1667, Cassini, in a letter to Mr Pettit, mentions his having for a long time carefully observed Venus through an excellent telescope made by Campani, in order to know whether that planet revolved on its axis or not, as he had before found Jupiter and Mars to do. But though he then observed some spots upon her, he says, that even when the air was quiet and clear, they appeared faint, irregular, and not well defined: so that it was difficult to have such a distinct view of any of them as to be certain that it was the same spot which was seen again in any subsequent observation; and this difficulty was increased, in the first place, when Venus was in her inferior semicircle; because at that time she must be viewed through the thick vapours near the horizon; though otherwise it was most proper, on account of her being then nearest to us. In the second place, if we would observe her at some height above those vapours, it could only be for a short time; and, thirdly, when she is low in her inferior circle, and at that time nearest the earth, the enlightened part of her is too small to discover any motion in it. He was therefore of opinion, that he should succeed better in his observations when the planet was about its mean distance from us, showing about one-half of her enlightened hemisphere; at which time also he could observe her for a much longer time above the gross atmospherical vapours. His first appearance of success was October 14. 1666 at three-quarters past five in the evening; when he saw a bright spot (fig. 37.), but could not then view that spot long enough to draw any inference concerning the planet's motion. He had no farther success till the 20th of April, the following year; when, about a quarter of an hour before sunrise, he began again to perceive on the disk of Venus, now about half enlightened, a bright part near the section, distant from the southern horn a little more than a fourth-part of the diameter of the disk, and near the eastern edge. He took notice also of a darkish oblong spot nearer to the northern than the southern horn: at sunrise the bright part was advanced further from the southern horn than when he first observed it; but though he was pleased to find that he had now a convincing proof of the planet's motion, he was surprised that the spots moved from south to north in the lower part of the disk, and from north to south in the upper part; a kind of motion of which we have no example, except in the librations of the moon.

Plate LXVI.

67 Why the spots seem to move south to north, &c.

This, however, was occasioned by the situation of the planet's axis. Cassini expected to have found the rotation of Venus similar to that of Jupiter and Mars, both of which have their axes perpendicular to their respective orbits, and turn round according to the order of the signs; so that, in each of them, the motion of the inferior half of their respective globe, or that part next the sun, is from east to west; in the superior half from west to east; but in Venus, whose axis is inclined 75 degrees towards her orbit, the coincidence is so near, that one-half of her disk appears to move from south to north, the other from north to south.

68 Particular account of the appearances of the spots at different times.

On the 21st of April, at sunrise, the bright part was a good way off the section, and about a fourth-part of the diameter distant from the southern horn. When the sun was eight degrees six minutes high, it seemed to be got beyond the center, and was cut through by the section. At the time the sun was seven degrees high the section cut it in the middle, which showed its motion to have some inclination towards the centre.

May 9. a little before sunrise, the bright spot was seen near the centre, a little to the northward, with two obscure ones situated between the section and the circumference, at a distance from each other, equal to that of each of them from the nearest angular point or horn of the planet. The weather being at that time clear, he observed for an hour and half a quarter the motion of the bright spot, which seemed to be exactly from south to north, without any sensible declination to east or west. A variation was at the same time perceived in the darkish spot too great to be ascribed to any optical cause. The bright spot was also seen on the 10th and 13th days of May before sunrise between the northern horn and the centre, and the same irregular change of darkish spots was taken notice of; but as the planet removed to a greater distance from the earth, it became more difficult to observe these appearances. The above phenomena are represented as they occurred in figs. 37—43.

69 Cassini's conclusions concerning the revolution of Venus on her axis.

But though, from the appearances just now related, M. Cassini was of opinion that Venus revolved on her axis, he was by no means so positive in this matter as with regard to Mars and Jupiter. "The spots on these (says he) I could attentively observe for a whole night, when the planets were in opposition to the sun:

I

Appearances of Celeſtial Bodies thro' Teleſcopes.

I could ſee them return to the ſame ſituation, and conſider their motion during ſome hours, and judge whether they were the ſame ſpots or not, and what time they took in turning round: but it was not the ſame with the ſpots of Venus; for they can be obſerved only for ſo ſhort a time, that it is much more difficult to

70
Difficulties attending theſe obſervations.

ſhow with certainty when they return into the ſame ſituation. I can, however, ſuppoſing that the bright ſpot which I obſerved on Venus, and particularly this year, was the ſame, ſay that ſhe finiſhes her motion, whether of rotation or libration, in leſs than a day; ſo that, in 23 days nearly, the ſpot comes into the ſame ſituation on nearly the ſame hour of the day, though not without ſome irregularity. Now ſuppoſing the bright ſpot obſerved to be always the ſame) whether this motion is an entire turning round or only a libration, is what I dare not poſitively affirm."

In 1669 M. Caſſini again obſerved Venus through a teleſcope, but could not then perceive any ſpots upon her ſurface; the reaſon of which Du Hamel conjectures to have been the fluctuation of the vapours near the horizon, which prevented them from being viſible. However, we hear nothing more of any ſpots being ſeen on her diſk till the year 1726; when, on

71
Bianchini's obſervations.

the 9th of February, Bianchini, with ſome of Campani's teleſcopes of 90 and 100 Roman palms, began to obſerve the planet at the altitude of 40° above the horizon, and continued his obſervations till, by the motion of ſeveral ſpots, he determined the poſition of her axis to be inclined as above mentioned, that the north pole pointed at a circle of latitude drawn through the 20th degree of Aquarius, elevated 15 or 20° above the orbit of Venus. He delineated alſo the figures of ſeveral ſpots which he ſuppoſed to be ſeas, and complimented the king of Portugal and ſome other great men by calling them by their names. Though none of Bianchini's obſervations were continued long enough to know whether the ſpots, at the end of the period aſſigned for the rotation of the planet, would have been in a different ſituation from what they were at the beginning of it; yet, from obſervations of two and of four days, he concluded the motion of the ſpots to be at the rate of 15° per day; at which advance the planet muſt turn round either once in 24 days or in 23 hours; but without farther obſervation it could

72
Doubts concerning the time ſhe takes up in revolving round her axis.

not be determined which of the two was the period of revolution; for if an obſerver ſhould at a particular hour, ſuppoſe ſeven in the evening, mark exactly the place of a ſpot, and at the ſame hour next evening find the ſpot advanced 15°, he would not be able to determine whether the ſpot had advanced only 15°, or had gone once quite round with the addition of 15° more in part of another rotation. Mr Bianchini, however, ſuppoſes Venus to revolve in 24 days eight hours; the principal proof adduced for which is an obſervation of three ſpots, A B C, being ſituated as

Plate LXVI.

in fig. 44. when they were viewed by himſelf and ſeveral perſons of diſtinction for about an hour, during which they could not perceive any change of place. The planet being then hid behind Barbarine palace, they could not have another view of her till three hours after, when the ſpots ſtill appeared unmoved. "Now (ſays M. Bianchini) if her rotation were ſo ſwift as to go round in 23 hours, in this ſecond view, three hours after the former, the ſpots muſt have advanced near 50 degrees; ſo that the ſpot C would have been gone off at R, the ſpot B would have ſucceeded into the place of C, the ſpot A into the place of B, and there would have been no more but two ſpots, A and B, to have been ſeen."

73
Diſpute between Caſſini and Bianchini.

Caſſini, the ſon, in a memoir for 1732, denies the concluſion of Bianchini to be certain. He ſays, that, during the three hours interval, the ſpot C might be gone off the diſk, and the ſpot B got into the place thereof, where, being near the edge, it would appear leſs than in the middle. That A, ſucceeding into the place of B, would appear larger than it had done near the edge, and that another ſpot might come into the place of A; and there were other ſpots beſides theſe three on the globe of the planet, as appears by the figures of Bianchini himſelf, particularly one which would naturally come into the place of A. That if the rotation of Venus be ſuppoſed to be in 23 hours, it will agree with Bianchini's, obſervations, as well as with thoſe of his father; but that, on the other ſuppoſition, the latter muſt be entirely rejected as erroneous: and he concludes with telling us, that Venus had frequently been obſerved in the moſt favourable times by M. Maraldi and himſelf with excellent teleſcopes of 80 and 100 feet focus, without their being able to ſee any diſtinct ſpot upon her diſk. "Perhaps, (ſays Dr Long), thoſe ſeen by Bianchini had diſappeared, or the air in France was not clear enough; which laſt might be the reaſon why his father could never ſee thoſe ſpots in France which he had obſerved in Italy, even when he made uſe of the longeſt teleſcopes. Neither of theſe aſtronomers take notice of any indentings in the curve which divides the illuminated part from the dark in the diſk of Venus, though in ſome views of that planet by Fontana and Ricciolus, the curve is indented; and it has from thence been concluded, that the ſurface of the planet is mountainous like that of the moon. This had alſo been ſuppoſed by Burratini, already mentioned; and a late writer has obſerved, that 'When the air is in a good ſtate for obſervation, mountains like thoſe of the moon may be obſerved with a very powerful teleſcope.'

74
Caſſini diſcovers her ſatellite.

Caſſini, beſides the diſcovery of the ſpots on the diſk of Venus by which he was enabled to aſcertain her revolution on an axis, had alſo a view of her ſatellite or moon, of which he gives the following account.—"A. D. 1686, Aug. 28th, at 15 minutes after four in the morning, looking at Venus with a teleſcope of 34 feet, I ſaw, at the diſtance of one-third of her diameter, eaſtward, a luminous appearance, of a ſhape not well defined, that ſeemed to have the ſame phaſe with Venus, which was then gibbous on the weſtern ſide. The diameter of this phenomenon was nearly equal to a fourth part of the diameter of Venus. I obſerved it attentively for a quarter of an hour, and having left off looking at it for four or five minutes, I ſaw it no more; but day-light was then advanced. I had ſeen a like phenomenon which reſembled the phaſe of Venus, Jan. 25th, A.D. 1672, from 52 minutes after ſix in the morning to two minutes after ſeven, when the brightneſs of the twilight made it diſappear. Venus was then horned, and this phenomenon, the diameter whereof was nearly a fourth-part of the diameter of Venus, was of the ſame ſhape. It was diſtant from the ſouthern horn of Venus, a diameter of the planet, on

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on the western side. In these two observations, I was in doubt whether it was not a satellite of Venus of such a consistence as not to be very well fitted to reflect the light of the sun; and which, in magnitude bore nearly the same proportion to Venus as the moon does to the earth, being at the same distance from the sun and the earth as Venus was, the phases whereof it resembled. Notwithstanding all the pains I took in looking for it after these two observations, and at divers other times, in order to complete so considerable a discovery, I was never able to see it. I therefore suspend my judgment of this phenomenon. If it should return often, there will be these two epochas, which, compared with other observations, may be of use to find out the periodical time of its return, if it can be reduced to any rule."

75 Discovered also by Mr Short.

A similar observation was made by Mr Short on the 23d of October 1740, about sunrise. He used at this time a reflecting telescope of about 16.5 inches, which magnified between 50 and 60 times, with which he perceived a small star at about 10′ distance from Venus, as measured by the micrometer; and putting on a magnifying power of 240 times, he found the star put on the same appearance with the planet herself. Its diameter was somewhat less than a third of that of the primary, but its light was less vivid, though exceedingly sharp and well defined. The same appearance continued with a magnifying power of 140 times. A line, passing through the centre of Venus and it, made an angle of 18 or 20 degrees with the equator: he saw it several times that morning for about the space of an hour, after which he lost sight of it, and could never find it again.

From this time the satellite of Venus, though very frequently looked for by Astronomers, could never be perceived, which made it generally believed that Cassini and Mr Short had been mistaken; but as the transits of the planet over the sun in 1761 and 1769 seemed to promise a greater certainty of finding it, the satellite was very carefully looked for by almost every one who had an opportunity of seeing the transit, but generally without success. M. Baudouin at Paris had provided a telescope of 25 feet, in order to observe the passage of the planet over the sun, and to look for its satellite; but he did not succeed either at that time or in the months of April and May following. M. Montaigne, however, one of the members of the Society of Limoges, had better success. On the 3d of May 1761, he perceived, about half an hour after nine at night, at the distance of 20′ from Venus, a small crescent, with the horns pointing the same way as those of the planet; the diameter of the former being about one-fourth of that of the latter; and a line drawn from Venus to the satellite making an angle with the vertical of about 20° towards the south. But though he repeated this observation several times, some doubt remained whether it was not a small star. Next day he saw the same star at the same hour, distant from Venus about half a minute, or a minute more than before, and making with the vertical an angle of 10° below on the north side; so that the satellite seemed to have described an arc of about 30°, whereof Venus was the centre, and the radius 20′. The two following nights were hazy, so that Venus could only be seen; but on the 7th of May, at the same hour as before, he saw the satellite again above Venus, and on the north side, at the distance of 25 or 26′ upon a line which made an angle of about 45°, with the vertical towards the right hand. The light of the satellite was always very weak, but it had the same phasis with its primary, whether viewed together with it in the field of his telescope or by itself. The telescope was nine feet long, and magnified an object between 40 and 50 times, but had no micrometer; so that the distance abovementioned are only from estimation.

76 Seen by M. Montaigne at the transit in 1761.

Fig. 4. Represents the three observations of M. Montaigne. V is the planet Venus; ZN the vertical. EC, a parallel to the ecliptic, making then an angle with the vertical of 45°; the numbers 3, 4, 7, mark the situations of the satellite on the respective days. From the figure it appears that the points 3 and 7 would have been diametrically opposite, had the satellite gone 15° more round the point V at the last observation; so that in four days it went through 155°. Then, as 155° is to four days or 96 hours, so is 360 to a fourth number, which gives 9 days 7 hours for the whole length of the synodical revolution. Hence M. Baudouin concluded, that the distance of this satellite was about 60 of the semidiameters of Venus from its surface; that its orbit cut the ecliptic nearly at right angles; had its ascending node in 22° of Virgo; and was in its greatest northern digression on the 7th atnine at night; and he supposed, that at the transit of the primary the satellite would be seen accompanying it. By a subsequent observation, however, on the 11th of May, he corrected his calculation of the periodical time of the satellite, which he now enlarged to 12 days; in consequence of which he found that it would not pass over the disk of the sun along with its primary, but go at the distance of above 20′ from his southern limb; though if the time of its revolution should be 15 hours longer than 12 days, it might then pass over the sun after Venus was gone off. He imagined the reason why this satellite was so difficult to be observed, might be, that one part of its globe was crusted over with spots, or otherwise unfit to reflect the light of the sun. By comparing the periodical time of this satellite with that of our moon, he computed the quantity of matter in Venus to be nearly equal to that in our earth; in which case it must have considerable influence in changing the obliquity of the ecliptic, the latitudes and longitudes of stars, &c.

Plate LX.

77 Why this satellite is so difficult to be seen.

This is all the evidence which has yet been published concerning the existence of the satellite of Venus; as it does not appear that, during the transit of 1769, any of the observers had the good fortune to perceive it. In the Philosophical Transactions for 1761, Mr Hirst gives an account of his having observed an atmosphere round the planet Venus. The observations were made at Fort St George; and looking attentively at that part of the sun's disk where he expected the planet would enter, he plainly perceived a faint shade or penumbra; on which he called out to his two assistants, "'Tis a coming!" and two or three seconds after, the first external contact took place in the moment whereof all the three agreed; but he could not see the penumbra after the egress: and of the other two gentlemen, one had gone home, and the other lost the planet out of the field of his telescope. Mr Dunn at Chelsea saw a penumbra, or small diminution of light,

78 Observations concerning the atmosphere of Venus.

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light, that grew darker and darker for about five seconds before the internal contact preceding the egress; from whence he determines that Venus is surrounded with an atmosphere of about 50 geographical miles high. His observations, he tells us, were made with an excellent six-feet Newtonian reflector, with a magnifying power of 110, and of 220 times: he had a clear dark glass next his eye, and the sun's limb appeared well defined; but a very narrow waterish penumbra appeared round Venus. The darkest part of the planet's phasis was at the distance of about a sixth-part of her diameter from its edge; from which an imperfect light encreased to the centre, and illuminated round about.

In the northern parts of Europe this penumbra could not be seen. Mr Wargentin, who communicated several observations of the first external contact, says, that he could not mark the time exactly, because of the undulation of the limb of the sun; but thought it very remarkable that, at the egress, the limb of Venus that was gone off the sun showed itself with a faint light during almost the whole time of emersion. Mr. Bergman, who was then at the observatory at Upsal, begins his account at the time when three-fourths of the disk of the planet was entered upon that of the sun; and he says, that the part which was not come upon the sun was visible, though dark, and surrounded

Plate LXI. by a crescent of faint light, as in fig. 7.: but this appearance was much more remarkable at the egress; for as soon as any part of the planet was got off the sun, that part was visible with a like crescent, but brighter, fig. 8. As more of the planetary disk went off that of the sun, however, that part of the crescent which was farthest from the sun grew fainter, and vanished, until at last only the horns could be seen, as in fig. 9. The total ingress was not instantaneous: but, as two drops of water, when about to part, form a ligament between them; so there was a dark swelling stretched out between Venus and the sun, as in fig. 10.; and when this ligament broke, the planet appeared to have got about an eighth-part of her diameter from the nearest limb of the sun; fig. 11. he saw the like appearance at going off, but not so distinct, fig. 12. Mr Chappe likewise took notice, that the part of Venus which was not upon the sun was visible during part of the time of ingress and egress; that it was farther surrounded by a small luminous ring of a deep yellow near the place that appeared in the form of the crescent, which was much brighter at the going off than coming upon the sun; and that, during the whole time the disk of Venus was upon the sun, he saw nothing of it. The time of the total ingress was instantaneous like a flash of lightening; but at the egress the limb of the sun began to be obscured three seconds before the interior contact. Some of the French astronomers attributed this luminous ring round Venus to the inflection of the sun's rays, as they also do the light seen round the moon in solar eclipses; but Mr Chappe supposes it to have been owing to the sun enlightening more than one half of the planetary globe, though he owns this cause not to be altogether sufficient. Mr Fouchy, who observed the transit at La Muette in France, perceived, during the whole time, a kind of ring round Venus, brighter than the rest of the sun, which became fainter the farther it went from the planet, but appeared more vivid in proportion as the sun was clearer. Mr. Ferner, who observed at the same place, confirms the testimony of Mr Fouchy. "During the whole time (says he) of my observing with the telescope, and the blue and green glasses, I perceived a light round about Venus, which followed her like a luminous atmosphere more or less lively, according as the air was more or less clear. Its extent altered in the same manner; nor was it well terminated; throwing out, as it were, some feeble rays on all sides."

79 Dr Long's opinion on these observations.

"I am not clear (says Dr. Long) as to the meaning of the luminous circle here mentioned, whether, when the whole planet was upon the sun, they saw a ring of light round it, distinct from the light of the sun; or whether they mean only the light which surrounded that part of Venus that was not upon the sun." Mr Chappe takes this and other accounts of the observations made in France in this latter sense: and though he sometimes called the luminous part of the crescent that surrounded the part of the planet not upon the sun a ring, he explains himself, that he did so, because at the coming upon the sun he perceived it at one side of the planet, and on the opposite side on its going off: for which reason he supposed that it surrounded it on all sides. See fig. 13. 14.

80 Spots when first seen on Mars.

5. Much larger and more remarkable spots have been perceived on the disk of Mars than that of any other primary planet. They were first observed in 1666 by Cassini at Bologna, with a telescope of Campani about $16\frac{1}{2}$ feet long; and continuing to observe them for a month, he found they came into the same situation in 24 hours and 40 minutes. The planet was observed by some astronomers at Rome with longer telescopes made by Eustachio Divini; but they assigned to it a rotation in 13 hours only. This, however, was afterwards shown by Mr Cassini to have been a mistake, and to have arisen from their not distinguishing the opposite sides of the planet, which it seems have spots pretty much alike. He made further observations on the spots of this planet in 1670; from whence he drew an additional confirmation of the time the planet took to revolve. The spots were again observed in subsequent oppositions; particularly for several days in 1704 by Maraldi, who took notice that they were not always well defined, and that they not only changed their shape frequently in the space between two oppositions, but even in the space of a month. Some of them, however, continued of the same form long enough to ascertain the time of the planet's revolution. Among these there appeared this year an oblong spot, resembling one of the belts of Jupiter when broken. It did not reach quite round the body of the planet; but had, not far from the middle of it, a small protuberance towards the north, so well defined that he was thereby enabled to settle the period of its revolution at 24 hours 39 minutes; only one minute less than what Cassini had determined it to be. See fig. 45. Plate LXVII.

The near approach of Mars to the earth in 1719 gave a much better opportunity of viewing him than had been obtained before; as he was then within $2\frac{1}{2}$ deg. of his perihelion, and at the same time in opposition to the sun. His apparent magnitude and brightness were thus so much increased, that he was by the vulgar taken for a new star. His appearance at that

time,

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Plate LXVII.

time, as seen by Maraldi through a telescope of 34 feet long, is represented fig. 46. There was then a long belt that reached half way round, to the end of which another shorter belt was joined, forming an obtuse angle with the former, as in fig. 47. This angular point was observed on the 19th and 20th of August, at 11 hours 15 minutes, a little east of the middle of the disk; and 37 days after, on the 25th and 26th of September, returned to the same situation. This interval, divided by 36, the number of revolutions contained in it gives 24 hours 40 minutes for the period of one revolution; which was verified by another spot of a triangular shape, one angle whereof was towards the north pole, and the base towards the south, which on the 5th and 6th of August appeared as in fig. 48. and after 72 revolutions returned to the same situation on the 16th and 17th of October. The appearances of Mars, as delineated by Mr Hook, when viewed through a 36 feet telescope, are represented fig. 28. He appeared through this instrument as big as the full moon. Some of the belts of this planet are said to be parallel to his equator; but that seen by Maraldi was very much inclined to it.

Plate LXIV.

81 Bright spots about the poles of Mars.

Besides these dark spots, the former astronomers took notice, that a segment of his globe about the south pole exceeded the rest of his disk so much in brightness, that it appeared beyond them as if it were the segment of a larger globe. Maraldi informs us, that this bright spot had been taken notice of for 60 years, and was more permanent than the other spots on the planet. One part of it is brighter than the rest, and the least bright part is subject to great changes, and has sometimes disappeared.

82 Mr Herschel's account of these spots.

A similar brightness about the north pole of Mars was also sometimes observed; and these observations are now confirmed by Mr Herschel, who hath viewed the planet with much better instruments, and much higher magnifying powers than any other astronomer ever was in possession of. His observations were made with a view to determine the figure of the planet, the position of his axis, &c. A very particular account of them is given in the 74th volume of the Philosophical Transactions, but which our limits will not allow us to insert. Figs 49—72. show the particular appearances of Mars, as viewed on the days there marked. The magnifying powers he used were sometimes as high as 932; and with this the south polar spot was found to be in diameter 41‴. Fig. 73 shows the connection of the other figures marked 64, 65, 66, 67, 68, 69, 70, which complete the whole equatorial succession of spots on the disk of the planet. The centre of the circle marked 65 is placed on the circumference of the inner circle, by making its distance from the circle marked 67 answer to the interval of time between the two observations, properly calculated and reduced to sidereal measure. The same is done with regard to the circles marked 66, 67, &c.; and it will be found by placing any one of these connected circles in such a manner as to have its contents in a similar situation with the figures in the single representation, which bears the same number, that there is a sufficient resemblance between them; though some allowance must undoubtedly be made for the distortions occasioned by this kind of projection.

Plate LXVII.

With regard to the bright spots themselves, Mr Herschel informs us, that the poles of the planet are not exactly in the middle of them, though nearly so. "From the appearance and disappearance (says he) of the bright north polar spot in the year 1781, we collect that the circle of its motion was at some considerable distance from the pole. By calculation, its latitude must have been about 76 or 77° north; for I find that, to the inhabitants of Mars, the declination of the sun, June 25th, 12 hours 15 minutes of our time was about 9° 56′ south; and the spot must have been so far removed from the north pole as to fall a few degrees within the enlightened part of the disk to become visible to us. The south pole of Mars could not be many degrees from the centre of the large bright southern spot of the year 1781; though this spot was of such a magnitude as to cover all the polar regions farther than the 70th or 65th degree; and in that part which was on the meridian, July 3d, at 10 hours 54 minutes, perhaps a little farther.

83 Causes of the appearance and disappearance of these spots.

"From the appearances of the south polar spot in 1781, we may conclude that its centre was nearly polar. We find it continued visible all the time Mars revolved on his axis; and to present us generally with a pretty equal share of the luminous appearance, a spot which covered from 45 to 60° of a great circle on the globe of the planet, could not have any considerable polar distance. From the observations and calculations made concerning the poles of Mars, we may conclude, that his north pole must be directed towards some point of the heavens, between $9^s\ 24^\circ\ 35'$ and $0^s\ 7^\circ\ 15'$; because the change of the situation of the pole from left to right, which happened in the time the planet passed from one place to the other, is a plain indication of its having gone through the node of its axis. Next, we may also conclude, that the node must be considerably nearer the latter point of the ecliptic than the former; for, whatever be the inclination of the axis, it will be seen under equal angles at equal distances from the node. But by a trigonometrical process of solving a few triangles, we soon discover both the inclination of the axis and the place where it intersects the ecliptic at rectangles (which, for want of a better term, I have perhaps improperly called it *node*). Accordingly I find by the calculation, that the node is in 17° 47′ of Pisces, the north pole of Mars being directed towards that part of the heavens; and that the inclination of the axis to the ecliptic is 59° 40′. By further calculations we find that the pole of Mars, on the 17th of April 1777, was then actually 81° 27′ inclined to the ecliptic, and pointed towards the left as seen from the sun.

84 Of the exact position of the poles of Mars.

"The inclination and situation of the node of the axis of Mars, with respect to the ecliptic, being found, may be thus reduced to the orbit of the planet himself. Let E C (fig. 74.) be a part of the ecliptic, O M part of the orbit of Mars, P E O a line drawn from P, the celestial pole of Mars, through E, that point which has been determined to be the place of the node of the axis of Mars in the ecliptic, and continued to O, where it intersects his orbit. Now, if, according to M. de La Lande, we put the node of the orbit of Mars for 1783 in $1^s\ 17^\circ\ 58'$, we have from the place of the node of the axis, that is, $11^s\ 17^\circ\ 47'$, to the place of the node of the orbit, an arch E N of 60° 11′. In the triangle N E O, right angled

Plate LXVIII.

Fig. 26

The Principal fixed Stars in the North Hemisphere Delineated on the Plane of the Equator

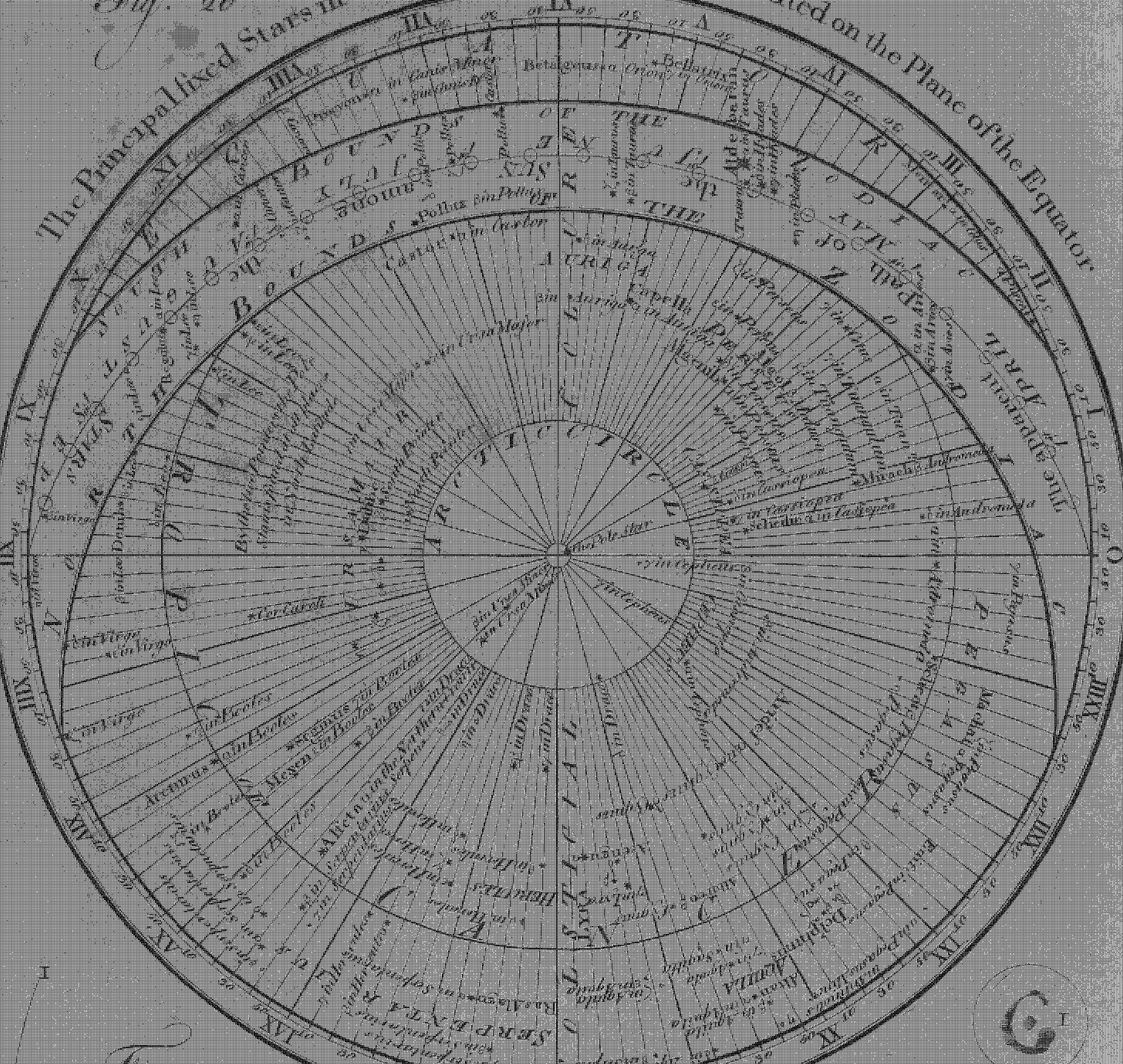


Fig. 27

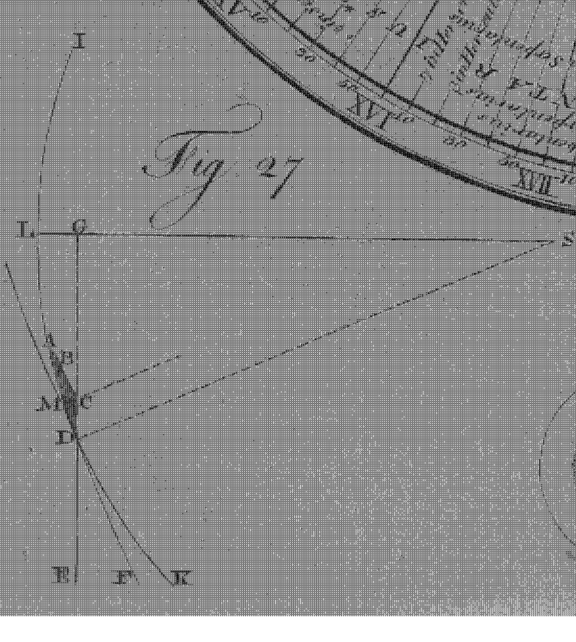
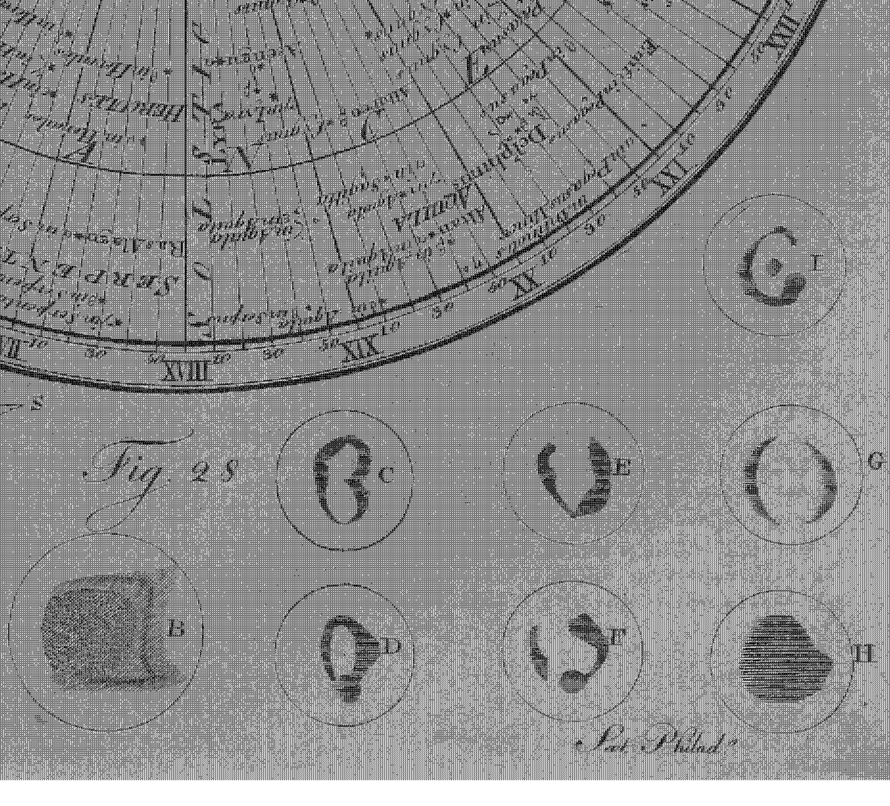


Fig. 28



Sat. Philad.

Appearances of Celeſtial Bodies thro' Teleſcopes.

at E, there is alſo given the angle E N O, according to the ſame author, 1° 51′, which is the inclination of the orbit of Mars to the ecliptic. Hence we find the angle E O N 89° 5′, and the ſide O N 60° 12′. Again, when Mars is in the node of its orbit N, we have by calculation the angle P N E = 63° 7′; to which adding the angle E N O = 1° 51′, we have P N O = 64° 58′: from which two angles, P O N and P N O, with the diſtance O N, we obtain the inclination of the axis of Mars, and place of its node with reſpect to its own orbit; the inclination being 61° 18′, and the place of the node of the axis 58° 31′ preceding the interſection of the ecliptic with the orbit of Mars, or in our 19° 28′ of Piſces."

85 Of the ſeaſons in Mars.

Our author next proceeds to ſhow how the ſeaſons in this planet may be calculated, &c. Which conjectures, though they belong properly to the next ſection, yet are ſo much connected with what has gone before, that we ſhall inſert here what he ſays upon the ſubject.

"Being thus acquainted with what the inhabitants of Mars will call the obliquity of their ecliptic, and the ſituation of their equinoctial and ſolſtitial points, we are furniſhed with the means of calculating the ſeaſons on that planet, and may account, in a manner which I think highly probable, for the remarkable appearance about its polar regions.

"But firſt, it may not be improper to give an inſtance how to reſolve any query concerning the Martial ſeaſons. Thus, let it be required to compute the declination of the ſun on Mars, June 25. 1781, at midnight of our time. If ♈, ♉, ♊, ♋, &c. (fig. 75.) repreſent the ecliptic of Mars, and ♈ ♋ ♎ ♑ the ecliptic of our planet, A *a*, *b* B, the mutual interſection of the Martial and terreſtrial ecliptics, then there is given the heliocentric longitude of Mars, ♈ *m* = 9ˢ 10° 30′: then taking away ſix ſigns, and ♎ *b* or ♈ *a* = 1ˢ 17° 58′, there remains *b m* = 1ˢ 22° 32′. From this arch, with the given inclination, 1° 51′ of the orbits to teach other, we have coſine of inclination to radius, as tangent of *b m* to tangent of B M = 1ˢ 22° 33′. And taking away B ♈ = 1ˢ 1° 29′, which is the complement to ♑ B (or ♋ A, already ſhown to be 1ˢ 28° 31′), there will remain ♈ M = 0ˢ 21° 4′, the place of Mars in its own orbit; that is, on the time above mentioned, the ſun's longitude on Mars will be 6ˢ 21° 4′; and the obliquity of the Martial ecliptic, 28° 42′, being alſo given, we find, by the uſual method, the ſun's declination, 9° 56′ ſouth.

86 Conſiderable reſemblance betwixt the earth and Mars.

"The analogy between Mars and the earth is perhaps by far the greateſt in the whole ſolar ſyſtem. Their diurnal motion is nearly the ſame; the obliquity of their reſpective ecliptics not very different; of all the ſuperior planets, the diſtance of Mars from the ſun is by far the neareſt alike to that of the earth: nor will the length of the Martial year appear very different from what we enjoy, when compared to the ſurpriſing duration of the years of Jupiter, Saturn, and the Georgium Sidus. If then we find that the globe we inhabit has its polar regions frozen and covered with mountains of ice and ſnow, that only partly melt when alternately expoſed to the ſun, I may well be permitted to ſurmiſe, that the ſame cauſes may probably have the ſame effect on the globe of Mars; that the bright polar ſpots are owing to the vivid reflection of light from frozen regions; and that the reduction of thoſe ſpots is to be aſcribed to their being expoſed to the ſun. In the year 1781, the ſouth polar ſpot was extremely large, which we might well expect as that pole had but lately been involved in a whole twelvemonth's darkneſs and abſence of the ſun; but in 1783, I found it conſiderably ſmaller than before, and it decreaſed continually from the 20th of May till about the middle of September, when it ſeemed to be at a ſtand. During this laſt period the ſouth pole had already been above eight months enjoying the benefit of ſummer, and ſtill continued to receive the ſun-beams, though, towards the latter end, in ſuch an oblique direction as to be but little benefited by them. On the other hand, in the year 1781, the north polar ſpot, which had then been its twelvemonth in the ſunſhine, and was but lately returning into darkneſs, appeared ſmall, though undoubtedly increaſing in ſize. Its not being viſible in the year 1783, is no objection to theſe phenomena; being owing to the poſition of the axis, by which it was removed out of ſight.

87 White ſpots about the poles of Mars ſuppoſed to be occaſioned by ſnow.

88 Of the ſpheroidal form of Mars.

"That a planetary globe, ſuch as Mars, turning on an axis, ſhould be of a ſpheroidical form, will eaſily find admittance, when two familiar inſtances in Jupiter and the earth, as well as the known laws of gravitation and the centrifugal force of rotatory bodies, lead the way to the reception of ſuch doctrines. So far from creating difficulties or doubts, it will rather appear ſingular, that the ſpheroidical form of this planet has not already been noticed by former aſtronomers; and yet, reflecting on the general appearances of Mars, we ſoon find, that opportunities of making obſervations on its real form cannot be very frequent: for when it is near enough to view it to an advantage, we ſee it generally gibbous; and its appoſitions are ſo ſcarce, and of ſo ſhort a duration, that in more than two years time we have not above three or four weeks for ſuch obſervations. Beſides, aſtronomers being generally accuſtomed to ſee this planet diſtorted, the ſpheroidical form might eaſily be overlooked.

89 Difference betwixt the equatorial and polar diameters of Mars.

"September 25. 1783. At 9h. 50′, the equatorial diameter of Mars meaſured 21″ 53‴; the polar diameter 21″ 15‴, *full meaſure*; that is certainly not too ſmall. This difference of the diameters was ſhown, on the 28th of the ſame month, to Mr Wilſon of Glaſgow, who ſaw it perfectly well, ſo as to be convinced that it was not owing to any defect or diſtortion occaſioned by the lens: and becauſe I wiſhed him to be ſatisfied of the reality of the appearance, I reminded him of ſeveral precautions; ſuch as cauſing the planet to paſs directly through the centre of the field of view, and judging of its figure when it was moſt diſtinct and beſt defined, &c. Next day the difference between the two diameters was ſhown to Dr Blagden and Mr Aubert. The former not only ſaw it immediately, but thought the flattening almoſt as much as that of Jupiter. Mr Aubert alſo ſaw it very plainly, ſo as to entertain no manner of doubt about the appearance.

"September 30th, 10h. 52′, the equatorial diameter was 22″ 9‴, with a magnifying power of 278. By a ſecond meaſure it was 22″ 31‴, full large; the polar diameter, very exact, was 21″ 26‴. On the 1ſt of October, at 10h. 50′, the equatorial diameter meaſured 103 by the micrometer, and the polar 98; the value of the diviſions in ſeconds and thirds not being well determined,

determined, on account of ſome changes lately made in the focal length of the object metals of the teleſcope. On the 13th, the equatorial diameter was exactly 22″ 35‴; the polar diameter 21″ 33‴." In a great number of ſucceeding obſervations, the ſame appearance occurred; but on account of the quick changes in the appearance of this planet, Mr Herſchel thought proper to ſettle the proportion betwixt the equatorial and polar diameters from thoſe which were made on the very day of the appoſition, and which were alſo to be preferred on account of their being repeated with a very high power, and in a fine clear air, with two different inſtruments of an excellent quality. From theſe he determined the proportions to be as 103 to 98, or 1355 to 1272.

90 Of the atmoſphere of Mars.

It has been commonly related by aſtronomers, that the atmoſphere of this planet is poſſeſſed of ſuch ſtrong refractive powers, as to render the ſmall fixed ſtars near which it paſſes inviſible. Dr Smith relates an obſervation of Caſſini, where a ſtar in the water of Aquarius, at the diſtance of ſix minutes from the diſk of Mars, became ſo faint before its occultation that it could not be ſeen by the naked eye, nor with a three-feet teleſcope. This would indicate an atmoſphere of a very extraordinary ſize and denſity; but the following obſervations of Mr Herſchel ſeem to ſhow that it is of much ſmaller dimenſions. "1783, Oct. 26th, There are two ſmall ſtars preceding Mars, of different ſizes; with 460 they appear both duſky red, and are pretty unequal; with 278 they appear conſiderably unequal. The diſtance from Mars of the neareſt, which is alſo the largeſt, with 227 meaſured 3′ 26″ 20‴. Some time after, the ſame evening, the diſtance was 3′ 8″ 55‴, Mars being retrograde. Both of them were ſeen very diſtinctly. They were viewed with a new 20 feet reflector, and appeared very bright. October 27th, the ſmall ſtar is not quite ſo bright in proportion to the large one as it was laſt night, being a good deal nearer to Mars, which is now on the ſide of the ſmall ſtar; but when the planet was drawn aſide, or out of view, it appeared as plainly as uſual. The diſtance of the ſmall ſtar was 2′ 5″ 25‴. The largeſt of the two ſtars (adds he), on which the above obſervations were made, cannot exceed the 12th, and the ſmalleſt the 13th or 14th magnitude; and I have no reaſon to ſuppoſe that they were any otherwiſe affected by the approach of Mars, than what the brightneſs of its ſuperior light may account for. From other phenomena it appears, however, that this planet is not without a conſiderable atmoſphere; for beſides the permanent ſpots on its ſurface, I have often noticed occaſional changes of partial bright belts, and alſo once a darkiſh one in a pretty high latitude; and theſe alterations we can hardly aſcribe to any other cauſe than the variable diſpoſition of clouds and vapours floating in the atmoſphere of the planet."

91 Belts of Jupiter, when firſt diſcovered.

6. Jupiter has the ſame general appearance with Mars, only that the belts on his ſurface are much larger and more permanent. Their general appearance, as deſcribed by Dr Long, is repreſented fig. 76—79.; by Mr Dunn, fig. 18.; by Mr Wollaſton fig. 21. 22, 22.; and by Mr Ferguſon, fig. 153. But they are not to be ſeen but by an excellent teleſcope. They are ſaid to have been firſt diſcovered by Fontana and two other Italians; but Caſſini was the firſt who gave a good account of them. Their number is very variable, as ſometimes only one, and at others no fewer than eight, may be perceived. They are generally parallel to one another, but not always ſo; and their breadth is likewiſe variable, one belt having been obſerved to grow narrow, while another in its neighbourhood has increaſed in breadth, as if the one had flowed into the other: and in this caſe Dr Long obſerves, that a part of an oblique belt lay between them, as if to form a communication for this purpoſe. The time of their continuance is very uncertain, ſometimes remaining unchanged for three months; at others, new belts have been formed in an hour or two.

92 Spots ſometimes appear in them.

In ſome of theſe belts large black ſpots have appeared, which moved ſwiftly over the diſk from eaſt to weſt, and returned in a ſhort time to the ſame place; from whence the rotation of this planet about its axis has been determined. On the 9th of May 1664, Dr Hook, with a good 12 feet teleſcope, obſerved a ſmall ſpot in the biggeſt of the three obſcure belts of Jupiter; and obſerving it from time to time, found that in two hours it had moved from eaſt to weſt about half the viſible diameter of the planet. In 1665, Caſſini obſerved a ſpot near the largeſt belt of Jupiter which is moſt frequently ſeen. It appeared round, and moved with the greateſt velocity when in the middle, but appeared narrower, and moved ſlower, the nearer it was to the circumference. "Theſe circumſtances (ſays Dr Long), ſhowed that the ſpot adhered to the body of Jupiter, and was carried round upon it. It continued thereon till the year following; long enough to determine the periodical time of Jupiter's rotation upon his axis to be nine hours 56 minutes."

93 Account of one theſe ſpots.

This principal, or ancient ſpot as it is called, is the largeſt, and of the longeſt continuance of any hitherto known, has appeared and vaniſhed no fewer than eight times between the years 1665 and 1708: from the year laſt mentioned it was inviſible till 1713. The longeſt time of its continuing to be viſible was three years; and the longeſt time of its diſappearing was from 1708 to 1713: it ſeems to have ſome connection with the principal ſouthern belt; for the ſpot has never been ſeen when that diſappeared, though that belt has often been viſible without the ſpot. Beſides this ancient ſpot, Caſſini, in the year 1699, ſaw one of leſs ſtability that did not continue, of the ſame ſhape or dimenſions, but broke into ſeveral ſmall ones, whereof the revolution was but nine hours 51 minutes; and two other ſpots that revolved in nine hours 52 minutes and a half. The figure of Jupiter is evidently an oblate ſpheroid, the longeſt diameter of his diſk being to the ſhorteſt as 13 to 12. His rotation is from weſt to eaſt, like that of the ſun, and the plane of his equator is very nearly coincident with that of his orbit; ſo that there can ſcarce be any difference of ſeaſons in that planet. His rotation has been obſerved to be ſomewhat quicker in his aphelion than his perihelion.

94 No difference of ſeaſons in Jupiter.

95 Is attended by four moons.

The moſt remarkable circumſtance attending this planet is his having four moons, which conſtantly revolve round him at different diſtances. See fig. 18. and 186. Theſe are all ſuppoſed to move in ellipſes; though the excentricities of all of them are too ſmall to be meaſured, excepting that of the fourth; and even this amounts to no more than 0.007 of its mean diſtance from the primary. The orbits of theſe planets were

thought

Appearances of Celestial Bodies thro' Telescopes.

thought by Galileo to be in the same plane with that of their primary: but M. Cassini has found that their orbits make a small angle with it; and as he did not find any difference in the place of their nodes, he concluded that they were all in the same place, and that their ascending nodes were in the middle of Aquarius. After observing them for more than 36 years, he found their greatest latitude, or deviation from the plane of Jupiter's orbit, to be 2° 55′. The first of these satellites revolves at the distance of 5.697 of Jupiter's semidiameters, or 1′ 51″ as measured by proper instruments; its periodical time is 1 d. 18 h. 27′ 34″. The next satellite revolves at the distance of 9.017 semidiameters, or 2′ 56″, in 3d. 13h. 13′ 42″; the third at the distance of 14.384 semidiameters, or 4′ 42″, in 7d. 3h. 42′ 36″; and the fourth at the distance of 25.266, or 8′ 16″, in 16d. 16h. 32′ 09″.

96 Distances and periodical times of Jupiter's moons.

Since the time of Cassini, it has been found that the nodes of Jupiter's satellites are not in the same place; and from the different points of view in which we have an opportunity of observing them from the earth, we see them sometimes apparently moving in straight lines, and at other times in elliptic curves. All of them, by reason of their immense distance, seem to keep near their primary, and their apparent motion is a kind of oscillation like that of a pendulum, going alternately from the geatest distance on one side to the greatest distance on the other, sometimes in a straight line, and sometimes in an elliptic curve. When a satellite is in its superior semicircle, or that half of its orbit which is more distant from the earth than Jupiter is, its motion appears to us direct, according to the order of the signs; but in its inferior semicircle, when it is nearer to us than Jupiter, its motion appears retrograde; and both these motions seem quicker the nearer the satellites are to the centre of the primary, slower the more distant they are, and at the greatest distance of all they appear for a short time to be stationary.

97 Occultations and eclipses of Jupiter's satellites.

From this account of the system of Jupiter and his satellites, it is evident, that occultations of them must frequently happen by their going behind their primary, or by coming in betwixt us and it. The former takes place when they proceed towards the middle of the upper semicircle; the latter, when they pass through the same part of their inferior semicircle. Occultations of the former kind happen to the first and second satellite; at every revolution, the third very rarely escapes an occultation, but the fourth more frequently by reason of its greater distance. It is seldom that a satellite can be discovered upon the disk of Jupiter, even by the best telescopes, excepting at its first entrance, when by reason of its being more directly illuminated by the rays of the sun than the planet itself, it appears like a lucid spot upon it. Sometimes, however, a satellite in passing over the disk, appears like a dark spot, and is easily to be distinguished. This is supposed to be owing to spots on the body of these secondary planets; and it is remarkable, that the same satellite has been known to pass over the disk at one time as a dark spot, and at another so luminous that it could not be distinguished from Jupiter himself, except at its coming on and going off. To account for this, we must say, that either the spots are subject to change; or if they be permanent, like those of our moon, that the satellites at different times turn different parts of their globes towards us. Possibly both these causes may contribute to produce the phenomena just mentioned. For these reasons also both the light and apparent magnitude of the satellites are variable: for the fewer spots there are upon that side which is turned towards us, the brighter it will appear; and as the bright side only can be seen, a satellite must appear larger the more of its bright side it turns towards the earth, and the less so the more it happens to be covered with spots. The fourth satellite, though generally the smallest, sometimes appears bigger than any of the rest: the third sometimes seems least, though usually the largest; nay, a satellite may be so covered with spots as to appear less than its shadow passing over the disk of the primary, though we are certain that the shadow must be smaller than the body which casts it. To a spectator placed on the surface of Jupiter, each of these satellites would put on the phases of the moon; but as the distance of any of them from Jupiter is but small when compared with the distance of that planet from the sun, the satellites are therefore illuminated by the sun very nearly in the same manner with the primary itself; hence they apper to us always round, having constantly the greatest part of their enlightened half turned towards the earth; and indeed they are so small, that were they to put on the phases of the moon, these phases could scarce be discerned through the best telescopes.

98 The satellites sometimes appear as dark spots

99 Why they vary in their light and apparent magnitude.

100 Their shadows sometimes visible on the disk of Jupiter.

When the satellites pass through their inferior semicircles, they may cast a shadow upon their primary, and thus cause an eclipse of the sun to his inhabitants if there are any; and in some situations this shadow may be observed going before or following the satellite. On the other hand, in passing through their superior semicircles, the satellites may be eclipsed in the same manner as our moon, by passing through the shadow of Jupiter: and this is actually the case with the first, second, and third of these bodies; but the fourth, by reason of the largeness of its orbit, passes sometimes above or below the shadow, as is the case with our moon. The beginnings and ending of these eclipses are easily seen by a telescope when the earth is in a proper situation with regard to Jupiter and the sun; but when this or any other planet is in conjunction with the sun, the superior brightness of that luminary renders both it and the satellites invisible. From the time of its first appearing after a conjunction until near the opposition, only the immersions of the satellites into his shadow, or the beginnings of the eclipses, are visible; at the opposition, only the occultations of the satellites, by going behind or coming before their primary, are observable; and from the opposition to the conjunction, only the emersions, or end of the eclipses, are to be seen. This is exactly true in the first satellite, of which we can never see an immersion with its immediately subsequent emersion: and it is but rarely that they can be both seen in the second; as in order to their being so, that satellite must be near one of its limits, at the same time that the planet is near his perihelion and quadrature with the sun. With regard to the third, when Jupiter is more than 46 degrees from conjunction with, or opposition to the sun, both its immersions and immediately subsequent emersions are visible; as they likewise are in the fourth, when the distance of Jupiter from conjunction or opposition is 24 degrees.

101 Three of Jupiter's moons eclipsed in every revolution.

102 At what time the eclipses, occultations, &c. of Jupiter's satelites are visible.

When

Appearances of Celestial Bodies thro' Telescopes.

When Jupiter is in quadrature with the sun, the earth is farthest out of the line that passes through the centres of the sun and Jupiter, and therefore the shadow of the planet is then most exposed to our view; but even then the body of the planet will hide from us one side of that part of the shadow which is nearest to it, through which the first satellite passes; which is the reason that, though we see the entrance of that satellite into the shadow, or its coming out from thence, as the earth is situated on the east or west side thereof, we cannot see them both; whereas the other satellites going through the shadow at a greater distance from Jupiter, their ingress and egress are both visible.

103 Telescopic appearance of Saturn.

7. Saturn, when viewed through a good telescope, makes a more remarkable appearance than any of the other planets. Galileo first discovered his uncommon shape, which he thought to be like two small globes, one on each side of a large one: and he published his discovery in a Latin sentence; the meaning of which was, that he had seen him appear with three bodies; though, in order to keep the discovery a secret, the letters were transposed. Having viewed him for two years, he was surprised to see him become quite round without these appendages, and then after some time to assume them as before. These adjoining globes were what are now called the *ansæ* of his ring, the true shape of which was first discovered by Huygens about 40 years after Galileo, first with a telescope of 12 feet, and then with one of 23 feet, which magnified objects 100 times. From the discoveries made by him and other astronomers, it appears that this planet is surrounded by a broad thin ring, the edge of which reflects little or none of the sun's light to us, but the planes of the ring reflect the light in the same manner that the planet itself does; and if we suppose the diameter of Saturn to be divided into three equal parts, the diameter of the ring is about seven of these parts. The ring is detached from the body of Saturn in such a manner, that the distance between the innermost part of the ring and the body is equal to its breadth. If we had a view of the planet and his ring, with our eyes, perpendicular to one of the planes of the latter, we should see them as in fig. 80.: but our eye is never so much elevated above either plane as to have the visual ray stand at right angles to it; nor indeed is it ever elevated more than about 30 degrees above it; so that the ring, being commonly viewed at an oblique angle, appears of an oval form, and through very good telescopes double, as represented fig. 18. and 153. Both the outward and inward rim is projected into an ellipsis, more or less oblong according to the different degrees of obliquity with which it is viewed. Sometimes our eye is in the plane of the ring, and then it becomes invisible; either because the outward edge is not fitted to reflect the sun's light, or more probably because it is too thin to be seen at such a distance. As the plane of this ring keeps always parallel to itself, that is, its situation in one part of the orbit is always parallel to that in any other part, it disappears twice in every revolution of the planet, that is, about once in 15 years; and he sometimes appears quite round for nine months together. At other times, the distance betwixt the body of the planet and the ring is very perceptible; insomuch that Mr Whiston tells us of Dr Clarke's father having seen a star through the opening, and supposed him to have been the only person who ever saw a sight so rare, as the opening, though certainly very large, appears very small to us. When Saturn appears round, if our eye be in the plane of the ring, it will appear as a dark line across the middle of the planet's disk; and if our eye be elevated above the plane of the ring, a shadowy belt will be visible, caused by the shadow of the ring as well as by the interposition of part of it betwixt the eye and the planet. The shadow of the ring is broadest when the sun is most elevated, but its obscure parts appear broadest when our eye is most elevated above the plane of it. When it appears double, the ring next the body of the planet appears brightest; when the ring appears of an elliptical form, the parts about the ends of the largest axis are called the *ansæ*, as has been already mentioned. These, a little before and after the disappearing of the ring, are of unequal magnitude: the largest ansa is longer visible before the planets round phase, and appears again sooner than the other. On the 1st of October 1714, the largest ansa was on the east side, and on the 12th on the west side of the disk of the planet, which makes it probable that the ring has a rotation round an axis: but whether or not this is the case with Saturn himself has not been discovered, on account of the deficiency of spots by which it might be determined. He has indeed two belts, discovered with very long telescopes, which appear parallel to that formed by the edge of the ring above mentioned; but these are rectilinear when the ring appears elliptic, as in fig. 81. and seem to be permanent. In 1683, however, Dom. Cassini and Fatio perceived a bright streak upon Saturn, which was not permanent like the dark belts, but was visible one day and disappeared the next, when another came into view near the edge of his disk. This induced Cassini to suppose, that Saturn might have a rotation round his axis; but the distance of this planet is so great, that we can scarce hope to determine his revolation so accurately as that of the others. It disappeared in May 1789; the earth being about to pass from its northern side, which is enlightened, to the southern, which is obscure.

104 His ring first discovered by Huygens.

105 Ring of Saturn probably has a revolution on its axis.

106 Belts discovered on Saturn.

The astronomer-royal (Dr Maskelyne) informs us of this disappearance in 1789, and reappearance in 1790, in the following manner: "On May 3d and August 26th 1789, the plane of Saturn's ring will pass through the earth; in October 11th it will pass through the sun; and January 29th 1790 it will again pass through the earth. Hence, and supposing with M. de la Lande that the ring is but just visible with the best telescopes in common use, when the sun is elevated 3′ above its plane, or 3 days before the plane passes through the sun, and when the earth is elevated 2¼′ above the plane, or one day from the earth's passing it, the phenomena of disappearance and reappearance may be expected to take place as follows.

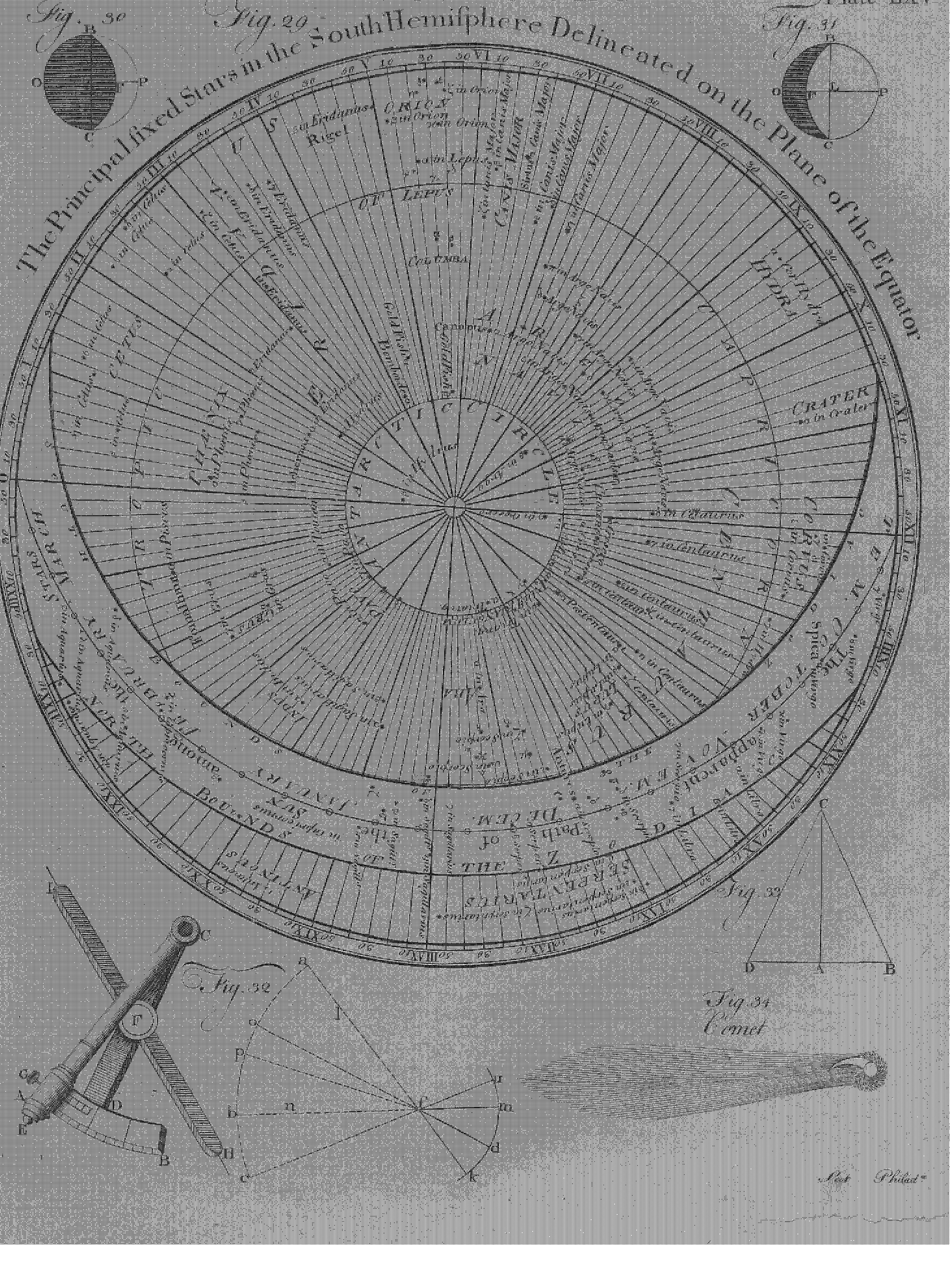
"May 2d 1789, Saturn's ring will disappear; the earth being about to pass from its northern side, which is enlightened, to its southern side, which is obscure.

"August 27th, the earth having repassed to the northern or enlightened side, the ring will reappear.

"October 8th, the ring will disappear; its plane being near passing through the sun, when it will change its enlightened side from the northern to the southern one,

ASTRONOMY

Plate LXV



Appearances of Celeſtial Bodies thro' Telescopes.

one, conſequently the dark ſide will be then turned to the earth.

"January 30th 1790, the earth having paſſed from the northern or dark ſide of the ring, to the ſouthern or enlightened one, the ring will become viſible, to continue ſo until the year 1803."

In the diagram, fig. 159 are delineated the phaſes of the ring from its full appearance in the year 1782 to its diſappearance in 1789, and its full reappearance 1796.

107 His five ſatellites.

Saturn is ſtill better attended than Jupiter (ſee fig. 18. and 186); having, beſides the ring abovementioned, no fewer than five moons continually circulating round him. The firſt, at the diſtance of 2.097 ſemidiameters of his ring, and 4.893 of the planet itſelf, performs its revolution in 1d. 21h. 18′ 27″; the ſecond, at 2.686 ſemidiameters of the ring, and 6.268 of Saturn, revolves in 2d. 17h. 41′ 22″: the third, at the diſtance of 8.754 ſemidiameters of Saturn, and 3.752 of the ring, in 4d, 12h. 25′ 12″; the fourth, called the *Huygenian ſatellite*, at 8.698 ſemidiameters of the ring, and 20.295 of Saturn, revolves in 15d. 21h. 41′ 12″; while the fifth, placed at the vaſt diſtance of 59.154 ſemidiameters of Saturn, or 25.348 of his ring, does not perform its revolution in leſs than 79d. 7h. 47′ 00″. The orbits of all theſe ſatellites, except the fifth, are nearly in the ſame plane, which makes an angle with the plane of Saturn's orbit of about 31°; and by reaſon of their being inclined at ſuch large angles, they cannot paſs either acroſs their primary or behind it with reſpect to the earth, except when very near their nodes; ſo that eclipſes of them happen much more ſeldom than of the ſatellites of Juper. There is, however, an account in the Philoſ. Tranſact. of an occultation of the fourth ſatellite behind the body of Saturn; and there is a curious account by Caſſini, in the Memoirs of the Royal Academy for 1692, of a fixed ſtar being covered by the fourth ſatellite, ſo that for 13 minutes they appeared both as one ſtar. By

108 Fifth ſatellite ſometimes diſappears, and why.

reaſon of their extreme ſmallneſs, theſe ſatellites cannot be ſeen unleſs the air is very clear; and Dom. Caſſini for ſeveral years obſerved the fifth ſatellite to grow leſs and leſs as it went through the eaſtern part of its orbit until it became quite inviſible, while in the weſtern part it gradually became more and more bright until it arrived at its greateſt ſplendor.—"This phenomenon (ſays Dr Long) cannot be better accounted for than by ſuppoſing one half of the ſurface of this ſatallite to be unfit to reflect the light of the ſun in ſufficient quantity to make it viſible, and that it turns round its axis nearly in the ſame time as it revolves round its primary; and that, by means of this rotation, and keeping always the ſame face toward Saturn, we upon the earth may during one half of its periodical time, be able to ſee ſucceſſively more and more of its bright ſide, and during the other half of its period have more and more of the ſpotted or dark ſide turned toward us. In the year 1705, this ſatellite unexpectedly became viſible in all parts of its orbit through the very ſame teleſcopes that were before often made uſe of to view it in the eaſtern part without ſucceſs: this ſhows the ſpots upon this ſatellite, like thoſe upon Jupiter and ſome other of the primary planets, are not permanent, but ſubject to change."

8. With regard to the Georgium Sidus, ſtill leſs is known than of Saturn. Its apparent magnitude is ſo ſmall, that it can ſeldom be ſeen with the naked eye; and even with the teleſcope it appears but of a few ſeconds diameter. It is attended by two ſatellites at the proportional diſtances marked in fig. 82. according to the obſervations of Mr. Herſchel; but he had not an opportunity of obſerving them long enough to determine their periodical times with exactneſs; though he ſuppoſes the innermoſt to perform its revolution in about eight days and three quarters, the other in thirteen days and a half.

109 Georgium Sidus attended by two ſatellites.

110 Of the comets.

9. The Comets, viewed through a teleſcope, have a very different appearance from any of the planets. The nucleus, or ſtar, ſeems much more dim. Sturmius tells us, that obſerving the comet of 1680 with a teleſcope, it appeared like a coal dimly glowing; or a rude maſs of matter illuminated with a duſky fumid light, leſs ſenſible at the extremes than in the middle; and not at all like a ſtar, which appears with a round diſk and a vivid light.

Hevelius obſerved of the comet in 1661, that its body was of a yellowiſh colour, bright and conſpicuous, but without any glittering light. In the middle was a denſe ruddy nucleus, almoſt equal to Jupiter, encompaſſed with a much fainter, thinner matter.—Feb. 5th. The nucleus was ſomewhat bigger and brighter, of a gold colour, but its light more duſky than the reſt of the ſtars; it appeared alſo divided into a number of parts.—Feb. 6th. The nuclei ſtill appeared, though leſs than before. One of them on the left ſide of the lower part of the diſk appeared to be much denſer and brighter than the reſt; its body round, and repreſenting a little lucid ſtar; the nuclei ſtill encompaſſed with another kind of matter.—Feb. 10th. The nuclei more obſcure and confuſed, but brighter at top than at bottom.—Feb. 13th. The head diminiſhed much both in brightneſs and in magnitude.—March 2d. Its roundneſs a little impaired, and the edges lacerated.—March 28th. Its matter much diſperſed; and no diſtinct nucleus at all appearing.

Wiegelius, who ſaw through a teleſcope the comet of 1664, the moon, and a little cloud illuminated by the ſun, at the ſame time; obſerved that the moon appeared of a continued luminous ſurface, but the comet very different, being perfectly like the little cloud enlightened by the ſun's beams.

111 Their atmoſpheres and phaſes.

The comets, too, are to appearance ſurrounded with atmoſpheres of a prodigious ſize, often ariſing ten times higher than the nucleus. They have often likewiſe different phaſes, like the moon.

112 Dr Long's account of them.

"The head of a comet (ſays Dr Long) to the eye, unaſſiſted by glaſſes, appears ſometimes like a cloudy ſtar; ſometimes ſhines with a dull light like that of the planet Saturn; ſome comets have been ſaid to equal, ſome to exceed, ſtars of the firſt magnitude; ſome to have ſurpaſſed Jupiter, and even Venus; and to have caſt a ſhadow as Venus ſometimes does.

"The head of a comet, ſeen through a good teleſcope, appears to conſiſt of a ſolid globe, and an atmoſphere that ſurrounds it. The ſolid part is frequently called the *nucleus*; which through a teleſcope is eaſily diſtinguiſhed from the atmoſphere or hairy appearance.

"A comet is generally attended with a blaze or tail, whereby it is diſtinguiſhed from a ſtar or planet;

as

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as it is alſo by its motion. Sometimes the tail only of a comet has been viſible at a place where the head has been all the while under the horizon; ſuch an appearance is called a *beam*.

113 Appearances of the comet of 1618.

"The nucleus of the comet of 1618 is ſaid, a few days after coming into view, to have broken into three or four parts of irregular figures. One obſerver compares them to ſo many burning coals; and ſays they changed their ſituation while he was looking at them, as when a perſon ſtirs a fire; and a few days after were broken into a great number of ſmaller pieces. Another account of the ſame is that on the 1ſt and 4th of December, the nucleus appeared to be a round, ſolid, and luminous body, of a duſky lead colour, larger than any ſtar of the firſt magnitude. On the 8th of the ſame month it was broken into three or four parts of irregular figures; and on the 20th was changed into a cluſter of ſmall ſtars.

114 Phenomena of their tails.

"As the tail of a comet is owing to the heat of the ſun, it grows larger as the comet approaches near to, and ſhortens as it recedes from, that luminary. If the tail of a comet were to continue of the ſame length, it would appear longer or ſhorter according to the different views of the ſpectator; for if his eye be in a line drawn through the middle of the tail lengthwiſe, or nearly ſo, the tail will not be diſtinguiſhed from the reſt of the atmoſphere, but the whole will appear round; if the eye be a little out of that line, the tail will appear ſhort as in fig. 83. and it is called a *bearded comet* when the tail hangs down towards the horizon, as in that figure. If the tail of a comet be viewed ſideways, the whole length of it is ſeen. It is obvoius to remark, that the nearer the eye is to the tail, the greater will be the apparent length thereof.

"The tails of comets often appear bent, as in fig. 84 and 85, owing to the reſiſtance of the æther; which, though extremely ſmall, may have a ſenſible effect on ſo thin a vapour as the tails conſiſts of. This bending is ſeen only when the earth is not in the plane of the orbit of the comet continued. When that plane paſſes thro' the eye of the ſpectator, the tail appears ſtraight, as in fig. 86, 87.

"Longomontanus mentions a comet, that, in 1618, Dec. 10th, had a tail above 100 degrees in length; which ſhows that it muſt then have been very near the earth. The tail of a comet will at the ſame time appear of different length in different places, according as the air in one place is clearer than in another. It need not be mentioned, that in the ſame place, the difference in the eyes of their ſpectators will be the cauſe of their diſagreeing in their eſtimate of the length of the tail of a comet.

115 Difference between the obſervations of Hevelius and Hooke.

"Hevelius is very particular in telling us, that he obſerved the comet of 1665 to caſt a ſhadow upon the tail; for in the middle thereof there appeared a dark line. It is ſomewhat ſurpriſing, that Hooke ſhould be poſitive in affirming, on the contrary, that the place where the ſhadow of that comet ſhould have been, if there had been any ſhadow, was brighter that any other part of the tail. He was of opinion that comets have ſome light of their own. His obſervations were made in a hurry; he owns they were ſhort and tranſitory: Hevelius's were made with ſo much care, that there is more reaſon to depend upon them. Dom. Caſſini obſerved, in the tail of the comet of 1680, a darkneſs in the middle; and the like was taken notice of by a curious obſerver in that of 1744.

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"There are three comets, viz. of 1680, 1744, and 1759, that deſerve to have a farther account given of them. The comet of 1680 was remarkable for its near approach to the ſun; ſo near, that in its perihelion it was not above a ſixth part of the diameter of that luminary from the ſurface thereof. Fig. 85, taken from Newton's Principia, repreſents ſo much of the trajectory of this comet as it paſſed through while it was viſible to the inhabitants of our earth, in going from and returning to its perihelion. It ſhows alſo the tail as it appeared on the days mentioned in the figure. The tail, like that of other comets, increaſed in length and brightneſs as it came nearer to the ſun; and grew ſhorter and fainter as it went farther from him and from the earth, till that and the comet were too far off to be any longer viſible.

116 Account of the comet of 1680.

117 Of that of 1744.

"The comet of 1744 was firſt ſeen at Lauſanne in Switzerland, Dec. 13th, 1743, N. S. From that time it increaſed in brightneſs and magnitude as it was coming nearer to the ſun. The diameter of it, when at the diſtance of the ſun from us, meaſured about one minute; which brings it out equal to three times the diameter of the earth. It came ſo near Mercury, that, if its attraction had been proportionable to its magnitude, it was thought probable it would have diſturbed the motion of that planet. Mr Betts of Oxford, however, from ſome obſervations made there, and at Lord Macclesfield's obſervatory at Sherburn, found, that when the comet was at its leaſt diſtance from Mercury, and almoſt twice as near the ſun as that planet was, it was ſtill diſtant from him a fifth part of the diſtance of the ſun from the earth; and could therefore have no effect upon the planet's motions. He judged the comet to be at leaſt equal in magnitude to the earth. He ſays, that in the evening of Jan. 23, this comet appeared exceedingly diſtinct and bright, and the diameter of its nucleus nearly equal to that of Jupiter. Its tail extended above 16 degrees from its body; and was in length, ſuppoſing the ſun's parallax 10″, no leſs than 23 millions of miles. Dr Bevis, in the month of May 1744, made four obſervations of Mercury, and found the places of that planet, calculated from correct tables, differed ſo little from the places obſerved, as to ſhow that the comet had no influence upon Mercury's motion.

"The nucleus, which had before been always round, on the 10th of February appeared oblong in the direction of the tail, and ſeemed divided into two parts by a black ſtroke in the middle. One of the parts had a ſort of beard brighter than the tail; this beard was ſurrounded by two unequal dark ſtrokes, that ſeparated the beard from the hair of the comet. The odd phenomena diſappeared the next day, and nothing was ſeen but irregular obſcure ſpaces like ſmoke in the middle of the tail; and the head reſumed its natural form. Feb. 15th, the tail was divided into two branches; the eaſtern part about ſeven or eight degrees long, the weſtern 24. On the 23d, the tail began to be bent; it ſhowed no tail till it was as near to the ſun as the orbit of Mars; the tail grew longer as it approached nearer the ſun; and at its greateſt length was computed to equal a third part of the diſtance of the earth from the ſun. Fig. 84. is a view of this comet, taken

by

Appearances of Celestial Bodies thro' Telescopes.

by an observer at Cambridge. I remember that in viewing it I thought the tail seemed to sparkle, or vibrate luminous particles. Hevelius mentions the like in other comets; and that their tails lengthen and shorten while we are viewing. This is probably owing to the motion of our air.

118 Of the comet of 1759.

"The comet of 1759 did not make any considerable appearance by reason of the unfavourable situation of the earth all the time, its tail might otherwise have been conspicuous; the comet being then too near the sun to be seen by us; but deserves our particular consideration, as it was the first that ever had its return foretold." See the following Section.

Hevelius gives pictures of comets of various shapes; as they are described by historians to have been like a sword, a buckle, a tun, &c. These are drawn by fancy only, from the description in words. He gives, however, also pictures of some comets, engraved by his own hand from the views he had of them through a very long and excellent telescope. In these we find changes in the nucleus and the atmosphere of the same comet. The nucleus of the comet of 1661, which in one observation appeared as one round body, as it is represented in fig. 87. in subsequent views seemed to consist of several smaller ones separated from one another, as in fig. 86. The atmosphere surrounding the nucleus, at different times, varied in the extent thereof; as did also the tail in length and breadth. The nuclei of other comets, as has already been observed, have sometimes phases like the moon. Those of 1744 and 1769 had both this kind of appearance. See fig. 34.

119 Number of fixed stars increased by telescope.

10. The fixed stars, when viewed through the best telescopes, appear not at all magnified, but rather diminished in bulk; by reason, as is thought by some, that the telescope takes off that twinkling appearance they make to the naked eye; but by others more probably, that the telescopic tube excludes a quantity of the rays of light, which are not only emitted from the particular stars themselves, but by many thousands more, which falling upon our eye-lids and the aërial particles about us, are reflected into our eyes so strongly as to excite vibrations, not only on those points of the retina where the images of the stars are formed, but also in other points at the same distance round about. This without the telescope makes us imagine the stars to be much bigger than when we see them only by a few rays coming directly from them, so as to enter our eyes without being intermixed with others. The number of stars appears increased prodigiously through the telescope; 70 stars have been counted in the constellation called *Pleiades*, and no fewer than 2000 in that of Orion. The late improvements of Mr Herschel, however, have shown the number of stars to be exceedingly beyond even what the discoveries of former astronomers would induce us to suppose. He has also shown, that many which to the eye, or through ordinary glasses, appear single, do in fact consist of two or more stars; and that the galaxy or milky-way owes its light entirely to multitudes of small stars placed so close that the naked eye, or even ordinary telescopes, cannot discover them.

120 Of the nebulæ.

He has shown also, that the nebulæ, or small whitish specks, discoverable by telescopes in various parts of the heavens, are owing to the same cause. Former astronomers could only reckon 103; but Dr Herschel has discovered upwards of 1250. He has also discovered a species of them, which he calls *planetary nebulæ*, on account of their brightness and shining with a well-defined disk, being also capable of being magnified more than the fixed stars.

Conclusions from the foregoing Appearances.

Sect. III. *Conclusions from the foregoing Appearances.*

The conjectures which have been formed concerning the nature of the celestial bodies are so numerous, that a recital of them would fill a volume; while at the same time many of them are so ridiculous, that absurdity itself would seem almost to have been exhausted on this subject.

121 Opinions of the ancients concerning the sun.

1. As a specimen of what were the opinions of the ancient philosophers concerning the nature of the sun, it may suffice to mention that Anaximander and Anaximenes held, that there was a circle of fire all along the heavens, which they called *the circle of the sun*; between the earth and this fiery circle was placed another circle of some opaque matter, in which there was a hole like the mouth of a German flute. Through this hole the light was transmitted, and appeared to the inhabitants of this earth as a round and distinct body of fire. The eclipses of the sun were occasioned by stopping this hole.

We must not, however, imagine, that the opinions of all the ancients were equally absurd with those of Anaximander and Anaximenes. Many of them had more just notions, though very imperfect and obscure. Anaxagoras held the sun to be a fiery globe of some solid substance, bigger than Peloponnesus; and many of the moderns have adopted this notion, only increasing the magnitude of the globe prodigiously. Sir Isaac Newton has proposed it as a query, Whether the sun and fixed stars are not great *Earths* made vehemently hot, whose parts are kept from fuming away by the vast weight and density of their superincumbent atmospheres, and whose heat is preserved by the prodigious action and reaction of their parts upon one another? But though Sir Isaac has proposed this as a query and taken the existence of a solar atmosphere for granted, there have yet been no proofs adduced in favour of that opinion besides those of analogy and probability. There is however, an appearance in the heavens termed the *semita luminosa*, or *zodiacal light*, which is now generally supposed to be owing to the sun's atmosphere. This was first discovered by Dom. Cassini in 1683. It is something like the milky-way, a faint twilight, or the tail of a comet, thin enough to let stars be seen through it, and seems to surround the sun in the form of a lens, the plane whereof is nearly coincident with that of the sun's equator. It is seen stretched along the zodiac, and accompanies the sun in his annual motion through the twelve signs. Each end terminates in an angle of about 21°: the extent of it in length from either of the angular points varies from 50 to 100°; it reaches beyond the orbit of Venus, but not so far as that of the earth. The breadth of it near the horizon is also various; from 12 almost to 30°: near the sun, where it may reasonably be supposed to be broadest, it cannot be seen. This light is weakest in the morning and strongest at night; disappearing in full

122 Of Sir Isaac Newton.

123 Of the existence of a solar atmosphere.

124 Semita luminosa, or zodiacal light.

Conclusions from the foregoing Appearances.

moonlight or in strong twilight, and therefore is not at all visible about midsummer in places so near either of the poles as to have their twilight all the night long, but may be seen in those places in the middle of winter both morning and evening, as it may in places under and near the equator all the year round. In north latitude it is most conspicuous after the evening twilight about the latter end of February, and before the morning twilight in the beginning of October; for at those times it stands most erect above the horizon, and is therefore clearest from the thick vapours of the twilight. Besides the difference of real extension of this light in length and breadth at different times, it is diminished by the nearness of any other light in the sky; not to mention that the extent of it will be differently determined by different spectators according to the goodness of their eyes.

125 Cassini's explanation of this phenomenon.

Cassini inquiring into the cause of this light, says first, that it might be owing to a great number of small planets surrounding the sun within the orbit of Venus; but soon rejects this for what he thinks a more probable solution, viz. that as by the rotation of the sun some gross parts are thrown up on his surface, whereof spots and nebulosities are formed; so the great rapidity wherewith the equatorial parts are moved, may throw out to a considerable distance a number of particles of a much finer texture, of sufficient density to reflect light: now, that this light was caused by an emanation from the sun, similar to that of the spots, he thought probable from the following observation: That after the year 1688, when this light began to grow weaker, no spots appeared upon the sun; whereas, in the preceding years, they were frequently seen there; and that the great inequality in the intervals between the times of the appearances of the solar spots has some analogy to the irregular returns of weakness and strength in this light, in like circumstances of the constitution of the air, and of the darkness of the sky. Cassini was of opinion that this light in the zodiac, as it is subject to great increase at one time and diminution at another, may sometimes become quite imperceptible; and thought this was the case in the years 1665, 1672, and 1681, when he saw nothing of it, though he surveyed with great attention those parts of the heaven where, according to his theory, it must have appeared if it had been as visible then as it was in others. He cites also passages out of several authors both ancient and modern, which make it probable that it had been seen both in former and latter ages, but without being sufficiently attended to, or its nature inquired into. It had been taken for the tail of a comet, part of the twilight, or a meteor of short continuance; and he was fully convinced of its having appeared formerly, from a passage in an English book of Mr Childrey's, printed in 1661. This passage is as follows:

126 Supposes some analogy between the solar spots and zodiacal light.

"There is something more that we would recommend to the observation of the mathematicians; namely, that in the month of February, and a little before and after it (as I have observed for several years), about six o'clock in the evening, when the twilight has entirely left the horizon, a path of light tending from the twilight towards the Pleiades, and touching them as it were, presented itself very plainly to my view. This path is to be seen when the weather is clear, but best of all when the moon does not shine." The same appearance is taken notice of in Gregory's Astronomy; and there expressly attributed to the sun's atmosphere.

With regard to the solar spots, Dr Long informs us, that "they do not change their places upon the sun, but adhere to his surface, or float in his atmosphere, very near his body; and if there be 20 spots or faculæ upon him at a time, they all keep in the same situation with respect to one another; and, as long as they last are carried round together in the same manner: by the motion of the spots therefore we learn what we should not otherwise have known, that *the sun is a globe, and has a rotation* about his axis." Notwithstanding this he tells us afterwards, "The spots, generally speaking, may be said to adhere to the sun, or to be so near him as to be carried round upon him uniformly; nevertheless, sometimes, though rarely, a spot has been seen to move with a velocity a little different from the rest; spots that were in different parallels have appeared to be carried along, not keeping always the same distance, but approaching nearer to each other; and when two spots moved in the same parallel, the hindmost has been observed to overtake and pass by the other. The revolution of spots near the equator of the sun is shorter than of those that are more distant from it."

127 Dr Long's opinion of the solar spots.

128 Of the sun's revolution on his axis.

The apparent change of shape in the spots, as they approach the circumference of the disk, according to our author, is likewise a proof of the sun's rotation round his axis, and that they either adhere to the surface of the luminary, or are carried round his atmosphere very near his surface.

"The rotation of the sun (says Dr Long) being known, we may consider his axis and poles, and their situation, as also his equator, or a circle imagined to be drawn upon that luminous globe equally distant from his poles; we may also imagine lesser circles drawn thereon, parallel to his equator.

"The rotation of the sun is according to the order of the signs; that is, any point on the surface of that vast globe turns round so as to look successively at Aries, Taurus, Gemini, &c. which is also the way that all the primary planets are carried round him, though each of them in a plane a little different from that of the rest. We must likewise observe, that the plane of the sun's equator produced does not coincide with the heliocentric orbit of any of the planets, but cuts every one of them at a small angle; it is nearest to coincidence with the orbit of Venus.

129 Visible part of the sun's globe less than the invisible.

"The sun being a globe at a great distance from us, we always see nearly one-half of that globe at a time; but the visible half is continually changing, by the rotation of the sun, and the revolution of the earth in her orbit. To speak accurately, we do not see quite half the sun's globe at a time, we want so much of it as the sun's apparent diameter amounts to; which, at his mean distance, is about 32 minutes; so much is the diameter of the invisible part of the sun greater than that of the visible part: for this reason a spot may be about two hours longer invisible than visible.

"The time between the entrance of a spot upon the disk and its exit therefrom, gives us nearly half the apparent period of the sun's rotation, which is usually in about 13 days; a spot that, after passing the disk and disappearing, returns again, gives the whole time,

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time, but not with preciſion; becauſe the ſpot may perhaps not keep all the while exactly in the ſame place, but have ſome floating motion of its own upon the ſurface of the ſun. Dom. Caſſini, taking notice that ſeveral ſpots had often appeared in the ſame parallel, thought that ſome particular places of the ſun might be more diſpoſed than others to ſupply the matter of theſe ſpots; and if ſo, that they would not move far from the place of their origin, juſt as the ſmoke of mount Ætna, if it could be ſeen from the ſun, would appear always to return to the ſame place of the diſk of the earth once every 24 hours, very nearly; ſometimes a little ſooner, ſometimes a little later, according as the ſmoke was driven by the wind from the place of its eruption. In conſequence of this ſuppoſition, he compared ſeveral large intervals between the appearances of ſpots carried in the ſame parallel, which he judged to be returns of the ſame ſpots ariſing out of the ſame place on the ſurface of the ſun, and found that 27 days 22 hours and 20 ſeconds was a common meaſure of thoſe intervals very nearly; this, therefore, he thought the moſt proper period to be taken for an apparent revolution of the ſolar ſpots, and conſequently of the ſun himſelf as ſeen from the earth. Theſe obſervations were made in April and May, nearly in the ſame time of the year, and therefore are not much affected by the inequality of the earth's motion. The ſame period is confirmed by Dom. Caſſini.

130 How to find the true time of a revolution of the ſpots. Fig. 3.

The time of the apparent revolution of a ſpot being known, the true time of its going round upon the ſun may be thus found: In fig. 3. the arc AC, which in the month of May, the earth goes through in her orbit in 27 days 12 hours and 20 minutes, is 26° 22′; the arc *a c* being equal to AC: the apparent revolution of a ſpot is the whole circle *a b c d*, or 360°, with the addition of the arc *a c* of 26° 22′, which makes 386° 22′: then ſay, as 386.22 is to 27 d. 12 h. 20′; ſo is 360° to 25 d. 15 h. 16′; the true time of the rotation of the ſun, as it would be ſeen from a fixed ſtar.

The angle of interſection of the ſun's equator with the ecliptic is but ſmall, according to Scheiner being never more than 8°, nor leſs than 6°; for which reaſon he ſettled it at 7°, though Caſſini makes it 7½.

131 Sun's nodes and limits.

This plane continued cuts the ecliptic in two oppoſite points, which are called the *ſun's nodes*, being 8° of ♊ and 8° of ♐; and two points in the ecliptic, 90° from the nodes, may be called the *limits*. Theſe are 8° of ♓ and 8° of ♍. When the earth is in either of theſe nodes, the equator of the ſun, if viſible, would appear as a ſtraight line; and, by reaſon of the vaſt diſtance of the ſun from us, all his parallels would likewiſe appear as ſtraight lines; but in every other ſituation of the earth, the equator and parallels of the ſun would, if viſible, appear as ellipſes growing wider the farther the earth is from the nodes, and wideſt of all when the earth is in one of her limits.

"In the preſent age (ſays Dr Long), on the 18th, of May, the earth is in the 8° of ♐, one of the nodes of the ſun, and conſequently the ſun's equator and parallels, if viſible, would appear as ſtraight lines, fig. 92. From that time the ſun's equator, and every parallel, begin to appear as half of an ellipſis convex, or ſwelling towards the ſouth, and growing wider every day to the 20th of Auguſt, where it is at the wideſt, as in fig. 93, the earth being then in the 8° of ♓, one of the limits. Immediately after, the apparent curvature of the ſun's equator and parallels continually decreaſes to the 19th of November, when they again appear as ſtraight lines, the earth being then in the other node. From that time the equator of the ſun and parallels become elliptical, convex towards the north; their curvature continually increaſing to the 15th of February, when the earth is arrived at the other limit; and their curvature then decreaſes continually to the 18th of May, when they again appear as ſtraight lines. Every ſpot is carried round the ſun in his equator, or in a parallel; therefore the apparent motion of the ſpots upon the ſun is rectilinear every year in May and November, at all other times elliptical." See fig. 16, 17. where the paths of ſome ſolar ſpots are delineated by Mr Dunn, in a manner ſeemingly inconſiſtent with what is juſt now delivered from Dr Long. From a farther conſideration of the nature of the paths deſcribed by the ſolar ſpots, the Doctor concludes that their appearance may be retarded about four hours by the unequal motion of the earth in its orbit.

132 Of the nature and formation of the ſolar ſpots.

The nature and formation of the ſolar ſpots have been the ſubject of much ſpeculation and conjecture. Some have thought that the ſun is an opaque body, mountainous and uneven, as our earth is, covered all over with a fiery and luminous fluid; that this fluid is ſubject to ebbing and flowing, after the manner of our tides, ſo as ſometimes to leave uncovered the tops of rocks or hills, which appear like black ſpots; and that the nebuloſities about them are cauſed by a kind of froth. Others have imagined, that the fluid which ſends us ſo much light and heat, contains a nucleus or ſolid globe, wherein are ſeveral volcanoes, that, like Ætna or Veſuvius, from time to time caſt up quantities of bituminous matter to the ſurface of the ſun, and form thoſe ſpots which are ſeen thereon; and that as this matter is gradually conſumed by the luminous fluid, the ſpots diſappear for a time, but are ſeen to riſe again in the ſame places when thoſe volcanoes caſt up new matter. A third opinion is, that the ſun conſiſts of a fiery luminous fluid, wherein are immerſed ſeveral opaque bodies of irregular ſhapes; and that theſe bodies, by the rapid motion of the ſun, are ſometimes buoyed or raiſed up to the ſurface, where they form the appearance of ſpots, which ſeem to change their ſhapes according as different ſides of them are preſented to the view. A fourth opinion is, that the ſun conſiſts of a fluid in continual agitation; that, by the rapid motion of this fluid, ſome parts more groſs than the reſt are carried up to the ſurface of the luminary, like the ſcum of melted metal riſing up to the top in a furnace: that theſe ſcums, as they are differently agitated by the motion of the fluid, form themſelves into thoſe ſpots we ſee on the ſolar diſk; and, beſides the optical changes already mentioned, grow larger, are diminiſhed in their apparent magnitude, recede a little from, or approach nearer to, each other, and are at laſt entirely diſſipated by the continual rapid motion of the fluid, or are otherwiſe conſumed or abſorbed.

133 Spots of the ſun ſuppoſed by Dr Wilſon to be hollows.

In the 64th volume of the Philoſophical Tranſactions, Dr Wilſon advances a new opinion concerning the ſolar ſpots, viz. that they are hollows in the ſurface of the luminary. "All the foregoing appearances (ſays he), when taken together, and when duly conſidered, ſeem to prove in the moſt convincing manner, that

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that the nucleus of this spot (December 1762) was considerably beneath the level of the sun's spherical surface.

"The next thing which I took into consideration was, to think of some means whereby I could form an estimate of its depth. At the time of the observation I had, on December 12th, remarked that the breadth of the side of the umbra next the limb was about 14″; but, for determining the point in question, it was also requisite to know the inclination of the shelving side of the umbra to the sun's spherical surface. And here it occurred, that, in the case of a large spot, this would in some measure be deduced from observation. For, at the time when the side of the umbra is just hid, or begins first to come in view, it is evident, that a line joining the eye and its observed edge, or uppermost limit, coincides with the plane of its declivity. By measuring therefore the distance of the edge from the limb, when this change takes place, and by representing it by a projection, the inclination or declivity may in some

134 His method of measuring their depth.

measure be ascertained. For in fig. 27, let ILDK be a portion of the sun's limb, and A B C D a section of the spot, S L the sun's semidiameter, L G the observed distance from the limb, when the side of the umbra changes; then will the plane of the umbra CD coincide with the line E D G drawn perpendicular to S L at the point G. Let F H be a tangent to the limb at the point D, and join S D.

"Since G L, the versed sine of the angle L S D, is given by observation, that angle is given, which by the figure is equal to F D E or G D H; which angle is therefore given, and is the angle of inclination of the plane of the umbra to the sun's spherical surface. In the small triangle therefore CMD, which may be considered as rectangular, the angle M D C is given, and the side D C equal to A B is given nearly by observation; therefore the side M C is given, which may be regarded as the depth of the nucleus without any material error.

"I had not an opportunity, in the course of the foregoing observations, to measure the distance G L, not having seen the spot at the time when either of the sides of the umbra changed. It is, however, certain, that when the spot came upon the disk for the second time, this change happened some time in the night between the 11th and 12th of December, and I judge that the distance of the plane of the umbra, when in a line with the eye, must have been about 1′ 55″ from the sun's eastern limb; from which we may safely conclude, that the nucleus of the spot was, at that time, not less than a semidiameter of the earth below the level of the sun's spherical surface, and made the bottom of an amazing cavity, from the surface downwards, whose other dimensions were of much greater extent."

135 His conjectures concerning the nature of the sun.

Having thus demonstrated that the solar spots are vast cavities in the sun, the Doctor next proceeds to offer some queries and conjectures concerning the nature of the sun himself, and to answer some objections to his hypothesis. He begins with asking, Whether it is not reasonable to think, that the vast body of the sun is made up of two kinds of matter very different in their qualities; that by far the greatest part is solid and dark; and that this dark globe is encompassed with a thin covering of that resplendent substance, from which the sun would seem to derive the whole of his vivifying heat and energy?—This, if granted, will afford a satisfactory solution of the appearance of spots; because, if any part of this resplendent surface shall be by any means displaced, the dark globe must necessarily appear; the bottom of the cavity corresponding to the nucleus, and the shelving sides to the umbra. The shining substance, he thinks, may be displaced by the action of some elastic vapour generated within the substance of the dark globe. This vapour, swelling into such a volume as to reach up to the surface of the luminous matter, would thereby throw it aside in all directions: and as we cannot expect any regularity in the production of such a vapour, the irregular appearance and disappearance of the spots is by that means accounted for; as the reflux of the luminous matter must always occasion the dark nucleus gradually to decrease, till at last it becomes indistinguishable from the rest of the surface.

Here an objection occurs, viz. That, on this supposition, the nucleus of a spot whilst on the decrease should always appear nearly circular, by the gradual descent of the luminous matter from all sides to cover it. But to this the Doctor replies, that in all probability the surface of the dark globe is very uneven and mountainous, which prevents the regular reflux of the shining matter. This, he thinks, is rendered very probable by the enormous mountains and cavities which are observed in the moon; and why, says he, may there not be the same on the surface of the sun? He thinks his hypothesis also confirmed by the dividing of the nucleus into several parts, which might arise from the luminous matter flowing in different channels in the bottom of the hollow.—The appearance of the umbra after the nucleus is gone, he thinks, may be owing to a cavity remaining in the luminous matter, tho' the dark globe is entirely covered.

As to a motion of the spots, distinct from what they are supposed to receive from the rotation of the sun round his axis, he says he never could observe any, except what might be attributed to the enlargement or diminution of them when in the neighbourhood of one another. "But (says he) what would farther contribute towards forming a judgment of this kind is, the apparent alteration of the relative place, which must arise from the motion across the disk on a spherical surface; a circumstance which I am uncertain if it has been sufficiently attended to."

The above mentioned hypothesis, the Doctor thinks, is further confirmed by the disappearance of the umbræ on the sides of the spots contiguous to one another; as the action of the elastic vapour must necessarily drive the luminous matter away from each, and thus as it were accumulate it between them, so that no umbra can be perceived. As to the luminous matter itself, he conjectures, that it cannot be any very ponderous fluid, but that it rather resembles a dense fog which broods on the surface of the sun's dark body. His general conclusion we shall give in his own words.

"According to the view of things given in the foregoing queries, there would seem to be something very extraordinary in the dark and unignited state of the great internal globe of the sun. Does not this seem to indicate that the luminous matter that encompasses it derives not its splendor from any intensity of heat? For, if this were the case, would not the parts underneath,

Conclusions from the foregoing Appearances.

neath, which would be perpetually in contact with that glowing matter, be heated to such a degree as to become luminous and bright? At the same time it must be confessed, that although the internal globe was in reality much ignited, yet when any part of it forming the nucleus of a spot is exposed to our view, and is seen in competition with a substance of such amazing splendor, it is no wonder that an inferior degree of light should, in these cases, be unperceivable.

136 Experiment proposed in order to confirm his hypothesis.

"In order to obtain some knowledge of this point, I think an experiment might be tried, if we had an opportunity of a very large spot, by making a contrivance in the eye-piece of a telescope, whereby an observer could look at the nuclues alone with the naked eye, without being in danger of light coming from any other part of the sun. In this case, if the observer found no greater splendor than what might be expected from a planet very near the sun, and illumined by as much of his surface as corresponds to the spot's umbra, we might reasonably conclude, that the solar matter, at the depth of the nucleus, is in reality not ignited. But from the nature of the thing, doth there seem any necessity for thinking that there prevails such a raging and fervent heat as many have imagined? It is proper here to attend to the distinction between this shining matter of the sun and the rays of light which proceed from it. It may perhaps be thought, that the reaction of the rays upon the matter, at their emission, may be productive of a violent degree of heat. But whoever would urge this argument in favour of the sun being intensely heated, as arising from the nature of the thing, ought to consider that all polished bodies are less and less disposed to be heated by the action of the rays of light, in proportion as their surfaces are more polished, and as their powers of reflection are brought to a greater degree of perfection. And is there not a strong analogy betwixt the reaction of light upon matter in cases where it is reflected and in cases where it is emitted?"

To this account of the solar spots, some objections have been made, particularly by Mr Wollaston, in the Philosophical Transactions, and M. de la Lande in the Memoirs of the Academy of Sciences; and to these Dr Wilson replied in the Philosophical Transactions for 1783, to the following purpose.

137 The Doctor's reply to objections.

"First of all (says he) it has been urged, as an objection of great weight, that the absence of the umbra on one side, where spots are near the limb, is not always constant; and of this I was sufficiently aware, having stated three cases from my own observation, when I did not perceive this change to take place. The reverend Francis Wollaston is the only person who, in the Philosophical Transactions, has bestowed any remarks on my publication; and though he acknowledges that the umbra generally changes in the manner I have determined, yet he expresses a difficulty as to my conclusion, on account of this circumstance not obtaining universally. Under similar expressions, M. de la Lande produces from his own observations, which appear to have been long continued, only three cases of the same kind, and four more from the ancient observations of M. Cassini and De la Hire. In regard to these last, I am not sure if such obsolete ones ought to be referred to in a question of the present kind. These excellent observers, entertaining no thought that any thing of moment depended upon a nice attention to the form of the spots, might easily overlook less obvious circumstances, especially when they were found near the limb. We may add further, that even when they were so situated, they retain the umbra at both ends; and that whole side of it which lies farthest from the centre of the disk and these parts in the aggregate, they might sometimes mistake for the umbra as not deficient in any particular place. But, even admitting the anomaly we at present consider to be much more frequent than can be contended for, still such cases can only be brought as so many exceptions to the general law or uniformity of appearance, from which the condition of by far the greatest number of spots is most undeniably deduced. The utmost therefore that can be alleged is, that some few spots differ from all the rest, or from the multitude; and are not, like them, excavations in the sun. But notwithstanding these few instances where the umbra is not found to change, when we consider how perfectly all spots resemble one another in their most striking features, there naturally rises some presumption for all under that description we have given, partaking of one common nature; and for this only difference in the phenomena depending upon something, which does not necessarily imply a complete generical distinction. It comes therefore to be inquired, how far spots, which when near the middle of the disk appear equal and similar in all things, may yet differ from one another as excavations, or as possessing the third dimension of depth? and how far the peculiar circumstances by which they may disagree, can contribute to make some resist this change of the umbra when near the limb much more than others?

"In order to this, suppose two spots which occupy a space upon the sun corresponding to the equal arches GD, fig. 94. and let GM, DM, be drawn so as to coincide with the plane of the excavation in such a case. The breadth of the nucleus being commonly equal to that of the surrounding umbra, if the base MD of the triangle GDM conceived rectilineal, be divided in L, so as ML : LD : : MD : DG; and if through L be drawn LS parallel to DG, then will DGSL be the section of two spots having this condition; and which, as to sense, would, when far away from the limb, be equal in all apparent measures; tho' very unequal in the third dimension HE, or depth of the nucleus SL, and also in the inclination DGM of their sides parallel to the spherical surface of the sun. Now it is manifest from the construction of the figure, that the distances AB, AK, from the limb A, when the sides GS of the umbra disappear, must depend very much on the latter of these two circumstances; and when, according as the angle of inclination, DGM is smaller, the respective spot will go nearer to the limb than the other before the side of the umbra GS vanishes. But these very exceptions to the general phenomena which we are at present examining are of this kind; and may perhaps, from what has been now shown, proceed wholly from the shallowness and the very gradual shelving of some few spots which break out in certain tracts of the sun's body, over which the luminous matter lies very thinly mantled.

"In order to avoid circumlocution, we may call that side of the umbra which lies nearest the limb the *nearest umbra*, and the side opposite the *farthest umbra*; and

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and to enter more particularly into the consideration now before us, let us suppose a spot of 40″ over all, with its nucleus and umbra equally broad; then will the depth of the nucleus, and the apparent breadth of the nearest umbra, when the plane of the farthest comes to coincide with the visual ray, be expressed as in the following examples, where the apparent semidiameter of the sun is supposed to be 16′, and his parallax 8.5″.

	Farthest umbra supposed to vanish when distant from the limb.	Depth of nucleus in English miles and seconds.		Apparent breadth of nearest umbra.
I.	1′ 0″	4.54″	2118	8.58
II.	0 30	3.09	1442	6.02
III.	0 15	2.09	975	4.13
IV.	0 8	1.44	672	2.87

"Now because in every aspect of a spot the real breadth of either the farthest or nearest umbra must be to the projected or apparent breadth as radius to the sine of the angle which this respective plane makes with the visual ray, it follows, that at any time before the spot comes so near the limb as is expressed in the above examples, the apparent breadth of the nearest and furthest umbra cannot differ so much as by the quantity there set down for the apparent breadth of the nearest when the other is supposed to vanish. Regarding, therefore, the farthest and nearest umbra of the spot in Case IV. as two neighbouring visible objects which turn narrower by degrees as the spot goes towards the limb, we should undoubtedly judge that they contract as to sense alike; since, so long as the farthest could be perceived, the other cannot appear to exceed it by a quantity that we could distinguish; and by the time the former coincides with the visual ray, the extreme nearness to the limb would prevent our forming any certain judgment of either.

"From this last example, therefore, it appears manifest, that a spot answering to the description and conditions therein mentioned, or one a little more shallow, would approach the limb, and finally go off the disk, without that peculiar change of the umbra on one side which is so obvious on common occasions, notwithstanding it were an excavation whose nucleus or bottom is so many miles below the level of the surface. In the four cases above stated, the distance of the remotest part of the nucleus from the sun's limb, when the visual ray coming from it is just interrupted by the lip of the excavation, or, in other words, the distance of the nucleus from the limb when it was totally hid, was also computed. These distances are as follows:

Case I.	-	16.93″	Case III.	-	4.70″
II.	-	8.90	IV.	-	2.70

And it is remarkable, from the two last, how very near the limb a shallow spot of not more than 40″ in diameter may come before the nucleus wholly disappears."

After describing the method in which these computations were made, the doctor proceeds thus: "Perhaps it may be urged, that very shallow spots ought always to be known from the rest, and discover themselves, by a surrounding umbra, very narrow, compared to the extent of the nucleus; but we know far too little of the qualities of the luminous matter, and of the proximate causes of the spots, to say any thing at all upon a point of this kind. The breadth of the umbra is, as assumed in the computations, about equal to that of the nucleus, though sometimes it varies more or less; but how far these relative dimensions indicate depth or shallowness must be expounded only by observation, and not by any vague and imperfect notions of the nature and constitution of the sun.

"The mention of a pit, or hollow or excavation several thousands of miles deep, reaching to that extent down through a luminous matter to darker regions, is ready to strike the imagination in a manner unfavourable to a just conception of the nature of the solar spots as now described. Upon first thoughts it may look strange how the sides and bottom of such vast abysses can remain so very long in sight, whilst, by the sun's rotation, they are made to present themselves more and more obliquely to our view. But when it is considered how extremely inconsiderable their greatest depth is compared to the diameter of the sun, and how very wide and shelving they are, all difficulties of this sort will be entirely removed." Unless, however, we duly attend to these proportions, our notions upon the subject must be very erroneous; and it seems the more necessary to offer this caution, as this very thing is inaccurately represented in fig. 9. belonging to the Memoir under view, and in a way that may lead to mistakes. Instead of exhibiting a spot as depressed below the surface of the sun one hundredth part of his semidiameter, the section of it is there determined by two lines drawn from the circumference, and meeting in a point at the prodigious distance of one-fifth of the semidiameter below. Any reader, therefore, who pleases, by turning to fig. 95. may see how very small a portion of the sun's body is made up of the luminous matter when supposed every where 3967 English miles deep. A is a section of a spot 50″ diameter, situated in the deepest part of this resplendent substance.

"What has now been insisted on at so much length concerning the shallowness and more gradual shelving of some few spots, will also apply to another objection which Mr de la Lande views in a strong light.

138 How a spot may appear to make an indentation on the sun's limb.

"Here we find quoted the great spot in 1719, seen by M. Cassini; and, for the second time, that of June 1703, seen by M. de la Hire; both which, on their arrival at the limb, are said to have made an indentation or dark notch in the disk; and this phenomenon is mentioned as absolutely incompatible with spots being below the surface.

"It is most true, that if we look for any thing like this when the plane which coincides with the external boundary of the spots passes through the eye, the way that M. de la Lande considers the matter, it must be very large indeed before the disk could be perceived deficient by any dark segment. But may not a spot, even no larger than M. Cassini's, considered as an excavation, make, in a manner very different from this, something like a notch; for, by the way, this phenomenon is not in the *Mem. Acad.* nor any where else that I know of, described with any sort of precision.—M. Cassini's great spot, by which we understood the nucleus, was of 30″; and supposing the umbra equally broad, its diameter over all must have been 1′ 30″. It would therefore occupy an extent upon the sun's surface of 5° 22′ fully. Now, suppose a circular space of that size upon the sun distinguished from the surrounding

Fig. 35

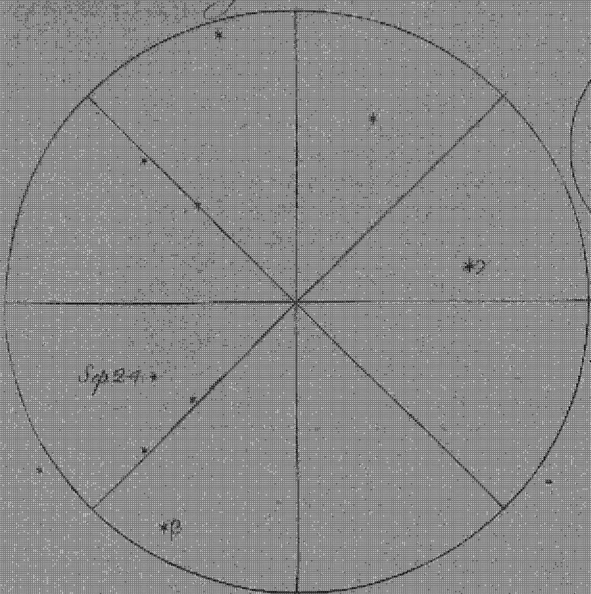


Fig. 37

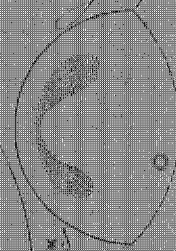
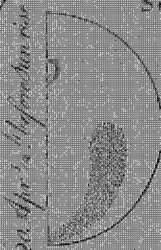


Fig. 38



South

Fig. 39

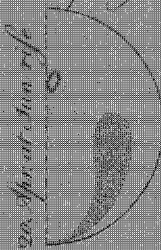


Fig. 40

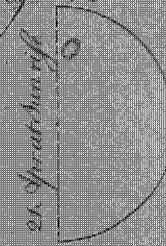


Fig. 41

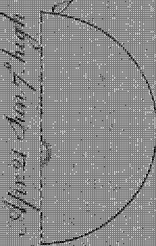
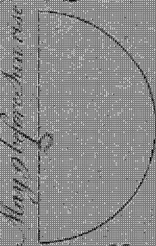


Fig. 42



North

Fig. 43

Fig. 44

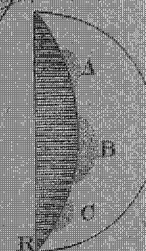
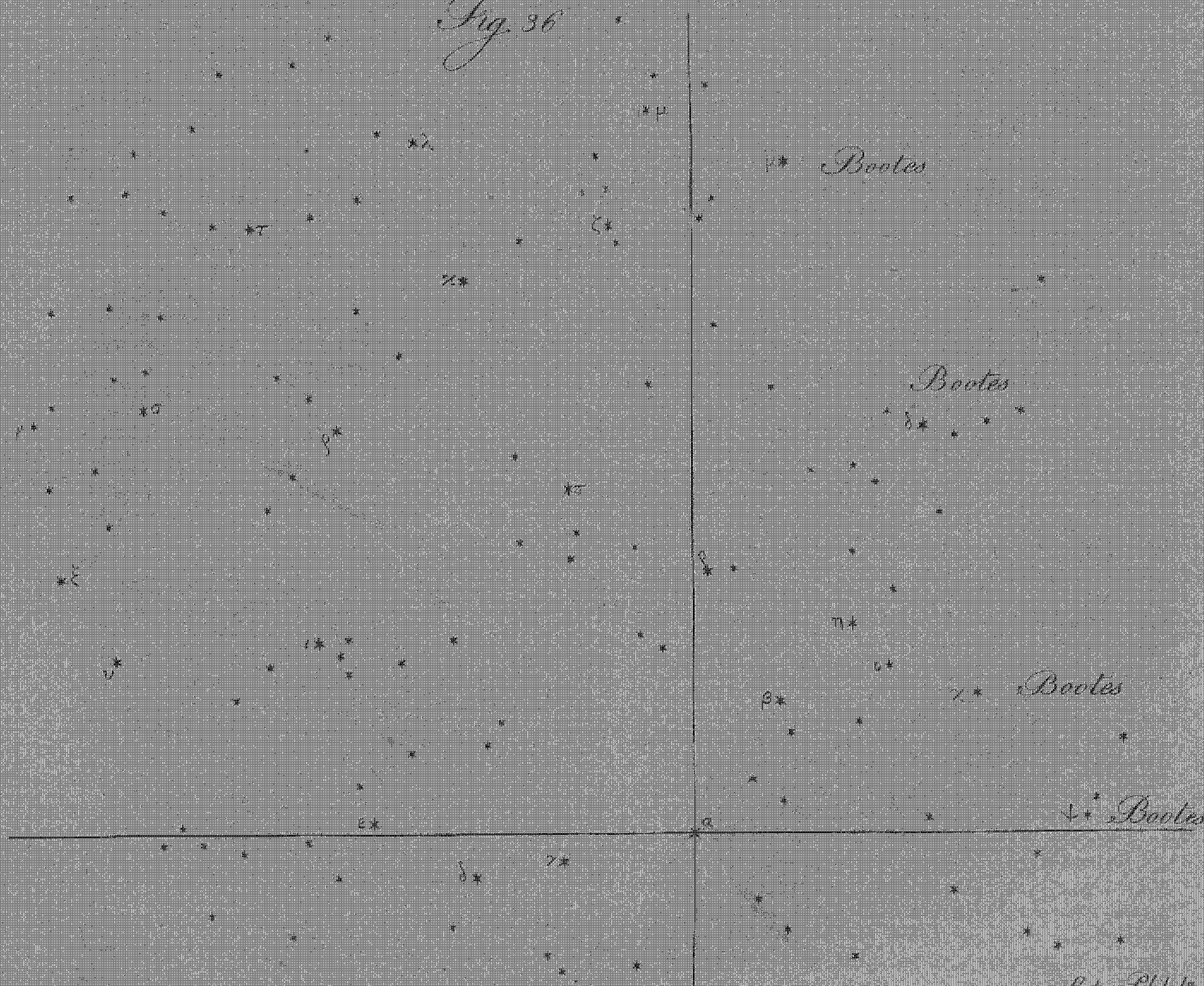


Fig. 36



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ing lustre by such a failure of light as is peculiar to some spots, and suppose that it just touches the limb, it would still subtend an angle of more than 4″. This being the case, might not a dusky shade, more or less remarkable according to the darkness of the umbra, commencing at the limb, and reaching inwards upon the disk, or in other words, a notch be perceived? Had M. Cassini's spot been a very shallow excavation, it appears by Case IV. that when viewed in this aspect, some small part of the nucleus might have yet been visible; and might have contributed, along with the shade of the farthest umbra, and the still broader and deeper shade of the two ends of the umbra, to mark out the indentation.

"Should it be said, that these notches are always distinct and jet-black impressions on the disk, of an obvious breadth, and originating entirely from the opaque nucleus conceived as something prominent above the general surface, this can be shewn inconsistent with some circumstances we find accidentally mentioned in the case of M. de la Hire's spot; for of this great one it was said, that when only 8″ distant from the limb, the nucleus was seen as a very narrow line. This was on June 3d 1703, at six o'clock in the morning. Now, forasmuch as at that time its alleged elevation must have been to its apparent subtense very nearly as radius to cosine of that arch of the sun's circumference whose versed sine was the 8′ of distance from the limb, it is impossible that its breadth could have increased sensibly in its further progress towards the limb; and how any obvious black notch could be produced by the elevation contended for in this case is not conceivable.

"I do not imagine, therefore, that the phenomena of notches in the disk, so inconsiderable and dubious as these seem to be, are by any means a proof of projecting nuclei, or that they are not reconcileable to spots being depressions on the sun. A large shallow excavation, with the sloping sides or umbra darker than the common, may, as has been shown, be more or less perceptible at the limb; and what perhaps is a further confirmation of this, and seems to evince that such a concurrence of circumstances is necessary, is, that sometimes even large spots make no indentation. M. Cassini, in *Mem. Acad.* Tom X. p. 581. describes the great spot of 1676, which he saw at its entrance with a telescope of 35 feet, as an obscure line, parallel to the limb: but no where mentions that it made a notch in it.

"Though we now and then see the surrounding umbra darker than at other times; yet when spots are deep, and the umbræ but little dusky, it is indeed impossible that we should see any thing of them, even though large, very near the limb: for here even the nucleus, which lies buried, cannot in the least contribute to the effect, as it may do a little before its state of evanescence, when spots are very shallow. Accordingly, cases of this kind are perfectly agreeable to experience.

"In reasoning concerning the nature of the spots, and particularly about their third dimension, the only arguments which are admissible, and which carry with them a perfect conviction, are those grounded upon the principles of optical projection. If, for example, the far greater number of them be excavations some thousands of miles deep, certain changes of the umbra would be observable when near the limb, as has been shown at so much length. Were they very shallow, or quite superficial, both sides of the umbra would as to sense contract alike in their progress toward the limb; for if, in case 4th above stated, the spot had been supposed superficial, the apparent breadth of the side of the umbra next the centre of the disk would have made them only 1.62′, and that of the side opposite 1.27′. Now, the whole of either of these quantities, and much more their difference, would be quite insensible. Again, if the nucleus extended much above the common level, whilst the surrounding umbra was superficial, we should behold the manifest indications of this by such an opaque body when seen very obliquely being projected across the farthest side of the umbra, and by hiding the whole or part of it before the time it would otherwise disappear. According to this or that condition of the spot, such things must infallibly obtain by the known laws of vision; and hence arguments resting upon such principles may be denominated optical ones. On the other hand, when spots are contemplated near the middle of the disk, a great variety of changes are observed in them, which depend not upon position, but upon certain physical causes producing real alterations in their form and dimensions. It is plain, that arguments derived from the consideration of such changes, and which, on that account, may be called *physical arguments*, can assist us but little in investigating their third dimensions; and, from the nature of the thing, must be liable to great uncertainty. The author of the *Memoire*, in p. 511, &c. takes new ground, and proceeds with a number of objections depending upon that sort of reasoning which we have last defined. I must take notice, that a certain distinction has been here overlooked, which in my paper I have endeavoured to point out. Presuming upon our great ignorance of many things which doubtless affect deeply the constitution of that wonderful body the sun, I offered in part II. an account of the productions, changes, and decay of the spots, considered as excavations, in the most loose and problematical manner; stating every thing on this head in the form of queries.—— Hence I would remark, that whatever inconsistencies are imagined in the account I have delivered Part II. though such may be justly chargeable on certain principles there assumed, yet they ought not to be stated as presumptions against the spots being really excavations or depressions in the luminous matter of the sun. This opinion must rest entirely upon the evidence held forth in the first part of the paper, whatever be the fate of the account laid down in the second. It does not enter there as an *hypothesis*, but as a matter of fact previously established by *optical arguments;* and from optical arguments alone can there arise even any just presumptions against it.

139

Remarks on M. de la Lande's theory of the solar spots.

"It remains now only to make a few strictures upon M. de la Lande's theory of the solar spots, humbly submitting them to the consideration of the reader. The import of it is, 'that the spots as phenomena arise from dark bodies like rocks, which by an alternate flux and reflux of the liquid igneous matter of the sun, sometimes raise their heads above the general surface. That part of the opaque rock, which at any time thus stands above, gives the appearance of the nucleus, whilst those parts,

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parts, which in each lie only a little under the igneous matter, appear to us as the surrounding umbra.'

"In the first place it may be remarked, that the whole proceeds upon mere supposition. This indeed the author himself very readily acknowledges. Though therefore it could not be disputed by arguments derived from observation, yet conjecture of any kind, if equally plausible, might fitly be employed to set aside its credit. Without entering into any tedious discussion, however, we shall confine ourselves to such particulars as appertain to the more obvious characters of the spots, and which also seem to be irreconcileable with the theory; and first of all with regard to the distinguishing features of the umbra.

"M. Cassini, Mem. Acad. tom. x. p. 582. Pl. VII. and M. de la Hire, Mem. Acad. 1703. p. 16. and I may add all other observers, and all good representations of the spots, bear testimony to the exterior boundary of the umbra being always well defined, and to the umbra itself being less and less shady the nearer it comes to the nucleus. Now it may be asked, how this could possibly be, according to M. de la Lande's theory? If the umbra be occasioned by our seeing parts of the opaque rock which lie a little under the surface of the igneous matter, should it not always be darkest next the nucleus? and, from the nucleus outward, should it not wax more and more bright, and at last lose itself in the general lustre of the sun's surface, and not terminate all at once in the darkest shade, as in fact it does? These few incongruities, which meet as it were in the very threshold of the theory, are so very palpable, that of themselves they raise unsurmountable doubts. For, generally speaking, the umbra immediately contiguous to the nucleus, instead of being very dark, as it ought to be, from our seeing the immersed parts of the opaque rock through a thin stratum of the igneous matter, is on the contrary very nearly of the same splendor as the external surface.

"Concerning the nucleus, or that part of the opaque rock, which stands above the surface of the sun, M. de la Lande produces no optical arguments in support of this third dimension or height. Neither does he say any thing particular as to the degree of elevation above the surface. But from what has been already hinted in the course of this paper, it appears that if this were any thing sensible, it ought to be discovered by phenomena very opposite to those which we have found to be so general.

"Again, a flux and reflux of the igneous matter, so considerable as sometimes to produce a great number of spots all over the middle zone, might affect the apparent diameter of the sun, making that which passes through his equator less than the polar one, by the retreat of the igneous matter towards those regions where no spots ever appear. But as a difference of this kind, of nearly one thousandth part of the whole would be perceivable, as we learn from M. de la Lande's own observations, compared with those of Mr. Short in *Histoire Acad.* 1760, p. 123. it would seem, that the theory had this difficulty also to combat. Further, when among spots very near one another some are observed to be increasing whilst others are diminishing, how is it possible this can be the effect of such a supposed flux and reflux? This last inconsistency is mentioned by the author himself, who endeavours to avoid it by making a new demand upon the general fund of hypothesis, deriving from thence such qualities of the igneous matter as the case seems to require; and such must be the method of proceeding in all systems merely theoretical. But it is unnecessary to pursue at more length illusive speculations of this kind, especially as we lie under a conviction founded on fact, of the theory being utterly erroneous. It hardly differs in any respect from that proposed by M. de la Hire, and a little amended by the writer of the *Histoire de l'Academie* for 1707, p. 111. Views very much of the same kind were even entertained by some so long ago as the days of Scheiner, as we find mentioned by that indefatigable author in his *Rosa Ursina*, p. 746."

140 Great inequalities on the surface of the moon.

2. Concerning the moon, it is allowed on all hands, that there are prodigious inequalities on her surface. This is proved by looking at her through a telescope, at any other time than when she is full; for then there is no regular line bounding light and darkness; but the confines of these parts appear as it were toothed and cut with innumerable notches and breaks; and even in the dark part, near the borders of the lucid surface, there are seen some small spaces enlightened by the sun's beams. Upon the fourth day after new moon, there may be perceived some shining points like rocks or small islands within the dark body of the moon; but not far from the confines of light and darkness there are observed other little spaces which join to the enlightened surface, but run out into the dark side, which by degrees change their figure, till at last they come wholly within the illuminated face, and have no dark parts round them at all. Afterwards many more shining spaces are observed to arise by degrees, and to appear within the dark side of the moon, which before they drew near to the confines of light and darkness were invisible, being without any light, and totally immersed in the shadow. The contrary is observed in the decreasing phases, where the lucid spaces which joined the illuminated surface by degrees recede from it, and after they are quite separated from the confines of light and darkness, remain for some time visible, till at last they also disappear. Now it is impossible that this should be the case, unless these shining points were higher than the rest of the surface, so that the light of the sun may reach them.

141 Method of measuring the lunar mountains. Fig. 20.

Not content with perceiving the bare existence of these lunar mountains, astronomers have endeavoured to measure their hight in the following manner. Let EGD be the hemisphere of the moon illuminated by the sun, ECD the diameter of the circle bounding light and darkness, and A the top of a hill within the dark part when it first begins to be illuminated. Observe with a telescope the proportion of the right line AE, or the distance of the point A from the lucid surface to the diameter of the moon ED; and because in this case the ray of light ES touches the globe of the moon, AEC will be a right angle by 16 prop. of Euclid's third book; and therefore in the triangle AEC having the two sides AE and EC, we can find out the third side AC; from which subducting BC or EC, there will remain AB the height of the mountain. Ricciolus affirms, that upon the fourth day after new moon he has observed the top of the hill called *St Catharine's* to be illuminated, and that it was distant from the confines of the lucid surface about a sixteenth part

of

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of the moon's diameter. Therefore, if CE=8, AE will be 1, and $AC^2=CE^2+AE^2$ by prop. 47. of Euclid's first book. Now the square of CE being 64, and the square of AE being 1, the square of AC will be 65, whose square root is 8,062, which expresses the length of AC. From which deducting BC=8, there will remain AB=0,062. So that CB or CE is therefore to AB as 8 is to 0,062, that is, as 8000 is to 62. If the diameter of the moon therefore was known, the height of this mountain would also be known. This demonstration is taken from Dr Keil, who supposes the semidiameter of the moon to be 1182 miles; according to which, the mountain must be somewhat more than nine miles of perpendicular height: but astronomer's having now determined the moon's semidiameter to be only 1090 miles, the height of the mountain will be nearly $8\frac{1}{4}$ miles.

142 Height of the lunar mountains over-rated.

In the former edition of this work, we could not help making some remarks on the improbability that the mountains of the moon, a planet so much inferior in size to the earth, should exceed in such vast proportion to the highest of our mountains, which are computed at little more than one-third of the height just mentioned.

143 Mr Herschel's observations on them.

Our remark is now confirmed by the observations of Mr Herschel. After explaining the method used by Galileo, Hevelius, &c. for measuring the lunar mountains, he tells us, that the former takes the distance of the top of a lunar mountain from the line that divides the illuminated part of the disk from that which is in the shade to be equal to one-twentieth of the moon's diameter; but Hevelius makes it only one-twenty-sixth. When we calculate the height of such a mountain, therefore, it will be found, according to Galileo, almost $5\frac{1}{4}$ miles; and according to Hevelius $3\frac{1}{2}$ miles, admitting the moon's diameter to be 2180 miles. Mr Ferguson, however, says, (Astronomy explained, § 252.), that some of her mountains, by comparing their height with her diameter, are found to be three times higher than the highest hills on earth; and Keil, in his Astronomical Lectures, has calculated the height of St. Catharine's hill, according to the observations of Ricciolus, and finds it nine miles. Having premised these accounts, Mr Herschel explains his method of taking the height of a lunar mountain from observations made when the moon was not in her quadrature as the method laid down by Hevelius answers only to that particular case: for in all others the projection must appear shorter than it really is. "Let SLM, says he, or *s l m*, (fig. 96.) be a line drawn from the sun to the mountain, touching the moon at L or *l*, and the mountain at M or *m*. Then, to an observer at E or *e*, the lines LM, *l m*, will not appear of the same length, though the mountains should be of an equal height; for LM will be projected into *o n*, and *l m* into ON. But these are the quantities that are taken by a micrometer when we observe a mountain to project from the line of illumination. From the observed quantity *o n*, when the moon is not in her quadrature, to find LM, we have the following analogy. The triangles *o* OL, *r* ML, are similar; therefore $Lo : LO :: Lr : LM$, or $\frac{LO \times on}{Lo} = LM$: but LO is the radius of the moon, and L*r* or *o n* is the observed distance of the mountain's projection; and L*o* is the sine of the angle ROL=*o*LS; which we may take to be the distance of the sun from the moon without any material error, and which therefore we may find at any given time from an ephemeris.

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"The telescope used in these observations was a Newtonian reflector of six feet eight inches focal length, to which a micrometer was adopted, consisting of two parallel hairs, one of which was moveable by means of a fine screw. The value of the parts shown by the index was determined by a trigonometrical observation of a known object at a known distance, and was verified by several trials. The power was always 222, excepting where another is expressly mentioned; and this was also determined by experiment which frequently differs from theory on account of some small errors in the data, hardly to be avoided. The moon having sufficient light, an aperture of no more than four inches was made use of; and, says Mr Herschel, "I believe, that, for distinctness of vision, this instrument is perhaps equal to any that ever was made."

With this instrument he observed a prominence, which he calls *a rock*, situated near the *Lacus Niger* of Hevelius, and found that it projected 41.56″. To reduce this into miles, put R for the semidiameter of the moon in seconds, as given by the nautical almanack at the time of observation, and Q for the observed quantity, also in seconds and centesimals; then it will be in general, $R : 1090 :: Q : \frac{1090Q}{R} = on$ in miles. Thus it is found, that 41.56″ is 46.79 miles. The distance of the sun from the moon at that time was, by the nautical almanack, about 93° $57\frac{1}{4}$′; the sine of which to the radius 1 is .9985, &c. and $\frac{on}{Lo}$ in this case is LM=46.85 miles. Then, by Hevelius's method, the perpendicular height of the rock is found to be about one mile. At the same time, a great many rocks, situated about the middle of the disk, projected from 25.92″ to 26.56″; which gives *o n* about 29.3 miles: so that these rocks are all less than half a mile high.

These observations were made on the 13th of November 1779. On the 13th of January 1780, examining the mountains of the moon, he found that there was not one of them fairly placed on level ground, which is very necessary for an exact measurement of the projection: for if there should be a declivity on the moon before the mountains, or a tract of hills placed so as to cast a shadow upon that part before them which would otherwise be illuminated, the projection would appear too large; and on the contrary, should there be a rising ground before them, it would appear too little.

Proceeding in this cautious manner, Mr Herschel measured the height of many of the lunar prominences, and draws at last the following conclusions.—"From these observations I believe it is evident, that the height of the lunar mountains in general is greatly over-rated; and that, when we have excepted a few, the generality do not exceed half a mile in their perpendicular elevation. It is not so easy to find any certain mountain exactly in the same situation it has been measured in before; therefore some little difference must be expected in these measures. Hitherto I have not had an opportunity of particularly observing the three mountains mentioned by Hevelius; nor that which

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which Ricciolus found to project a sixteenth part of the moon's diameter. If Keill had calculated the height of this last mentioned hill according to the theorem I have given, he would have found (supposing his observation to have been made, as he says, on the fourth day after new moon) that its perpendicular height could not well be less than between 11 and 12 miles. I shall not fail to take the first opportunity of observing these four, and every other mountain of any eminence; and if other persons, who are furnished with good telescopes and micrometers, would take the quantity of the projection of the lunar mountains, I make no doubt but that we should be nearly as well acquainted with their heights, as we are with the elevation of our own. One caution I would beg leave to mention to those who may use the excellent $3\frac{1}{2}$ feet refractors of Mr Dollond. The admirable quantity of light, which on most occasions is so desirable, will probably give the measure of the projection somewhat larger than the true, if not guarded against by proper limitations placed before the object-glass. I have taken no notice of any allowance to be made for the refraction a ray of light must suffer in passing through the atmosphere of the moon, when it illuminates the top of the mountain, whereby its apparent height will be lessened, as we are too little acquainted with that atmosphere to take it into consideration. It is also to be observed, that this would equally affect the conclusions of Hevelius, and therefore the difference in our inferences would still remain the same."

144 Caution to be observed in using Dollond's telescopes.

In the continuation of his observations Mr Herschel informs us that he had measured the height of one of the mountains which had been measured by Hevelius. "Antitaurus (says he), the mountain measured by Hevelius, was badly situated; because Mount Moschus, and its neighbouring hills cast a deep shadow which may be mistaken for the natural convexity of the moon. A good, full, but just measure, 25.105″; in miles, 29.27: therefore LM 31.7 miles, and the perpendicular height not quite half a mile. As great exactness was desired in this observation, it was repeated with very nearly the same result. Several other mountains were measured by the same method, and all his observations concurred in making the height of the lunar mountains much less than what former astronomers had done. Mount Lipulus was found to be near two-thirds of a mile; one of the Appenine mountains between Lacus Trasimenus and Pontus Euxinus measured a mile and a quarter; Mons Armenia, near Taurus, two-thirds of a mile; Mons Leucoptera three quarters of a mile. Mons Sacer projected 45.625″; 'but (says he) I am almost certain that there are two very considerable cavities or places where the ground descends below the level of the convexity, just before these mountains; so that these measures must of course be a good deal too large; but supposing them to be just, it follows, that *o n* is 50.193 miles, LM=64 miles, and the perpendicular height above $1\frac{3}{4}$ miles.'

145 Volcanoes discovered in the moon.

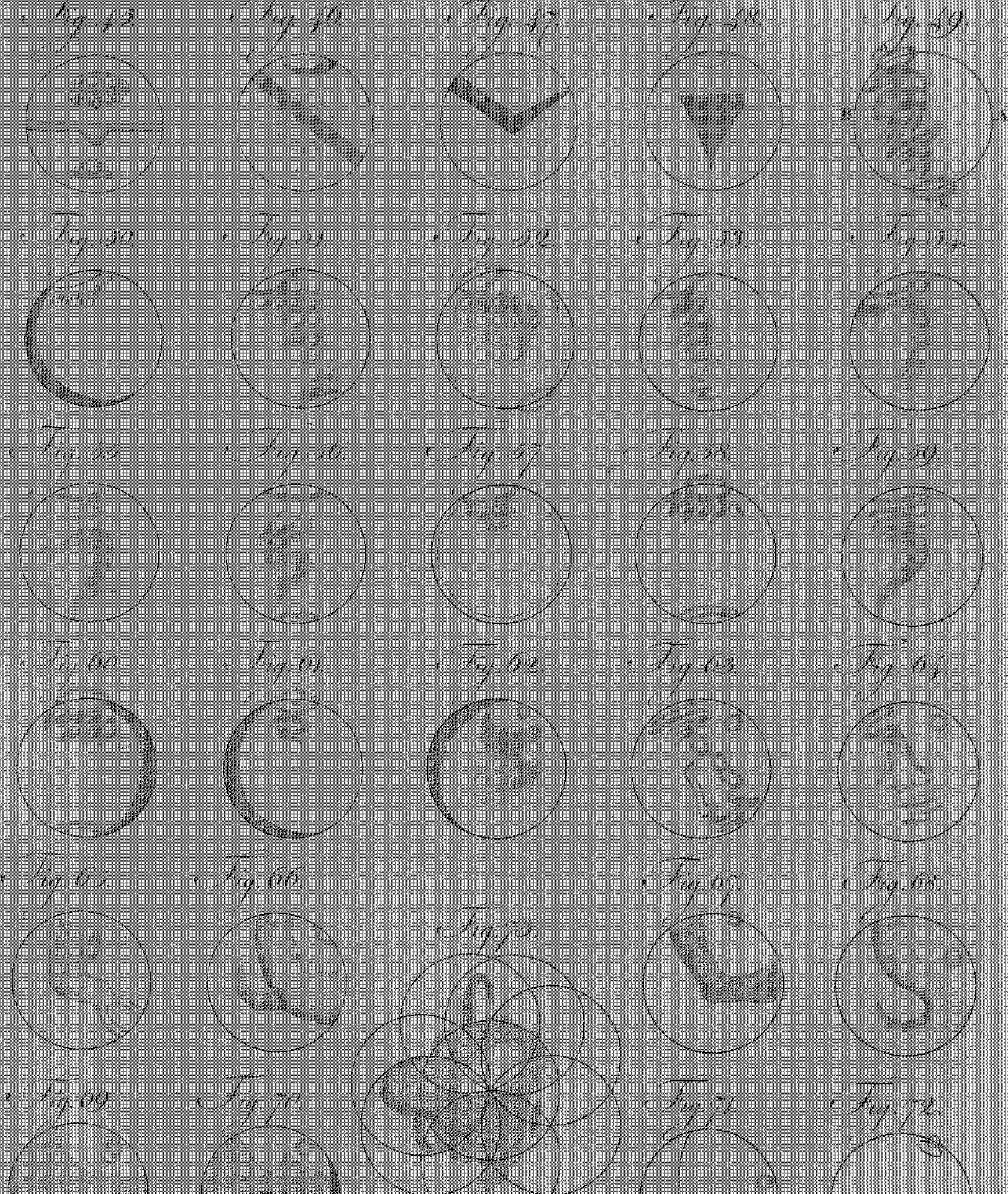
As the moon has on its surface mountains and valleys in common with the earth, some modern astronomers have discovered a still greater similarity, viz. that some of these are really volcanoes, emitting fire as those on earth do. An appearance of this kind was discovered some years ago by Don Ulloa in an eclipse of the sun. It was a bright small spot like a star near the margin of the moon, and which he at that time supposed to have been a hole with the sun's light shining through it. Succeeding observations, however, have induced astronomers to attribute appearances of this kind to the eruption of volcanic fire; and Mr Herschel has particularly observed several eruptions of the lunar volcanoes, the last of which he gives an account of in the Phil. Transf. for 1787. "April 19. 10h. 36, sidereal time. I perceive (says he) three volcanoes in different places of the dark part of the new moon. Two of them are either already nearly extinct, or otherwise in a state of going to break out; which perhaps may be decided next lunation. The third shows an actual eruption of fire or luminous matter. I measured the distance of the crater from the northern limb of the moon, and found it 3′ 57.3″: its light is much brighter than the nucleus of the comet which M. Mechain discovered at Paris the 10th of this month.

"April 20. 10 h. 2′ sidereal time. The volcano burns with greater violence than last night. Its diameter cannot be less than 3″, by comparing it with that of the Georgian planet: as Jupiter was near at hand, I turned the telescope to his third satellite, and estimated the diameter of the burning part of the volcano to be equal to at least twice that of the satellite; whence we may compute that the shining or burning matter must be above three miles in diameter. It is of an irregular round figure, and very sharply defined on the edges. The other two volcanoes are much farther towards the centre of the moon, and resemble large, pretty faint nebulæ, that are gradually much brighter in the middle; but no well-defined luminous spot can be discerned in them. These three spots are plainly to be distinguished from the rest of the marks upon the moon; for the reflection of the sun's rays from the earth is, in its present situation, sufficiently bright, with a ten-feet reflector, to show the moon's spots, even the darkest of them; nor did I perceive any similar phenomena last lunation, though I then viewed the same places with the same instrument.

"The appearance of what I have called the *actual fire*, or eruption of a volcano, exactly resembled a small piece of burning charcoal when it is covered by a very thin coat of white ashes, which frequently adhere to it when it has been some time ignited; and it had a degree of brightness about as strong as that with which such a coal would be seen to glow in faint daylight. All the adjacent part of the volcanic mountain seemed to be faintly illuminated by the eruption, and were gradually more obscure as they lay at a greater distance from the crater. This eruption resembled much that which I saw on the 4th of May in the year 1783, but differed considerably in magnitude and brightness; for the volcano of the year 1783, though much brighter than that which is now burning, was not near so large in the dimensions of its eruption: the former seen in the telescope resembled a star of the fourth magnitude as it appears to the naked eye; this, on the contrary, shows a visible disk of luminous matter very different from the sparkling brightness of star-light."

146 Conjectures concerning her surface.

Concerning the nature of the moon's substance there have been many conjectures formed. Some have imagined,



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gined, that, besides the light reflected from the sun, the moon hath also some obsure light of her own, by which she would be visible without being illuminated by the sun-beams. In proof of this it is urged, that during the time of even total eclipses the moon is still visible, appearing of a dull red colour, as if obscured by a great deal of smoke. In reply to this it hath been advanced, that this is not always the case; the moon sometimes disappearing totally in the time of an eclipse, so as not to be discernable by the best glasses, while little stars of the fifth and sixth magnitudes were distinctly seen as usual. This phenomenon was observed by Kepler twice, in the years 1580 and 1583; and by Hevelius in 1620. Ricciolus and other Jesuits at Bologna, and many people throughout Holland, observed the same on April 14, 1642; yet at Venice and Vienna she was all the time conspicuous. In the year 1703, Dec. 23, there was another total obscuration. At Arles, she appeared of a yellowish brown; at Avignon, ruddy and transparent, as if the sun had shone through her: at Marseilles, one part was reddish and the other very dusky; and at length, though in a clear sky, she totally disappeared. The general reason for her appearance at all during the time of eclipses shall be given afterwards: but as for these particular phenomena, they have not yet, as far as we know, been satisfactorily accounted for.

Different conjectures have also been formed concerning the spots on the moon's surface. Some philosophers have been so taken with the beauty of the brightest places observed in her disk, that they have imagined them to be rocks of diamonds; and others have compared them to pearls and precious stones. Dr Keill and the greatest part of astronomers now are of opinion, that those are only the tops of mountains which by reason of their elevation are more capable of reflecting the sun's light than others which are lower. The duskish spots, he says, cannot be seas, nor any thing of a liquid substance; because, when examined by the telescope, they appear to consist of an infinity of caverns and empty pits, whose shadows fall within them, which can never be the case with seas, or any liquid substance: but, even within these spots, brighter places are also to be observed; which, according to his hypothesis, ought to be the points of rocks standing up within the cavities. Dr Long, however, is of opinion that several of the dark spots on the moon are really water. May not the lunar seas and lakes (says he) have islands in them, wherein there may be pits and caverns? And if some of these dark parts be brighter than others, may not that be owing to the seas and lakes being of different depths, and to their having rocks in some places and flats in others?

It has also been urged, that if all the dark spots observed on the moon's surface were really the shadows of mountains, or of the sides of deep pits, they could not possibly be so permanent as they are found to be; but would vary according to the position of the moon with regard to the sun, as we find shadows on earth are varied according as the earth is turned towards or from the sun. Accordingly it is pretended, that variable spots are actually discovered on the moon's disk, and that the direction of these is always opposite to the sun. Hence they are found among those parts which are soonest illuminated in the increasing moon, and in the decreasing moon lose their light sooner than the intermediate ones; running round, and appearing sometimes longer, and sometimes shorter. The permanent dark spots, therefore, it is said, must be some matter which is not fitted for reflecting the rays of the sun so much as the bright parts do; and this property, we know by experience, belongs to water rather than land: whence these philosophers conclude, that the moon, as well as our earth, is made up of land and seas.

147 Whether the moon has any atmosphere.

It has been a matter of dispute whether the moon has any atmosphere or not. The following arguments have been urged by those who take the negative side. 1. The moon constantly appears with the same brightness when there are no clouds in our atmosphere; which could not be the case if she were surrounded with an atmosphere like ours, so variable in its density, and so frequently obscured by clouds and vapours. 2. In an appulse of the moon to a star, when she comes so near it that part of her atmosphere is interposed between our eye and the star, refraction would cause the latter seem to change its place, so that the moon would appear to touch it later than by her own motion she would do. 3. Some philosophers are of opinion, that because there are no seas or lakes in the moon, there is therefore no atmosphere, as there is no water to be raised up in vapours.

All these arguments, however, have been answered by other astronomers in the following manner. 1. It is denied that the moon appears always with the same brightness, even when our atmosphere appears equally clear. Hevelius relates, that he has several times found in skies perfectly clear, when even stars of the sixth and seventh magnitude were visible, that at the same altitude of the moon and the same elongation from the earth, and with one and the same telescope, the moon and its maculæ do not appear equally lucid, clear, and conspicuous at all times; but are much brighter and more distinct at some times than at others. From the circumstances of this observation, say they, it is evident that the reason of this phenomenon is neither in our air, in the tube, in the moon, nor in the spectator's eye; but must be looked for in something existing about the moon. An additional argument is drawn from the different appearances of the moon already mentioned in total eclipses, which are supposed to be owing to the different constitutions of the lunar atmosphere.

148 Why the light is not refracted by the moon's atmosphere.

To the second argument Dr Long replies, that Sir Isaac Newton has shown (*Princip.* prop. 37. cor. 5.), that the weight of any body upon the moon is but a third part of what the weight of the same would be upon the earth: now the expansion of the air is reciprocally as the weight that compresses it: the air, therefore, surrounding the moon, being pressed together by a weight, or being attracted towards the centre of the moon by a force equal only to one-third of that which attracts our air towards the centre of the earth, it thence follows, that the lunar atmosphere is only one-third as dense as that of the earth, which is too little to produce any sensible refraction of the star's light. Other astronomers have contended that such refraction was sometimes very apparent. Mr. Cassini says that he frequently observed Saturn, Jupiter, and the fixed stars, to have their circular figure changed into an elliptical one, when they approached either to the moon's dark or illuminated limb, though they own,

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own, that, in other occultations, no such change could be observed. With regard to the fixed stars, indeed, it has been urged, that, granting the moon to have an atmosphere of the same nature and quantity as ours, no such effect as a gradual diminution of light ought to take place; at least, that we could by no means be capable of perceiving it. Our atmosphere is found to be so rare at the height of 44 miles as to be incapable of refracting the rays of light. This height is the 180th part of the earth's diameter; but since clouds are never observed higher than four miles, we must conclude that the vaporous or obscure part is only one 1980th. The mean apparent diameter of the moon is 31′ 29″, or 1889 seconds: therefore the obscure parts of her atmosphere, when viewed from the earth, must subtend an angle of less than one second; which space is passed over by the moon in less than two seconds of time. It can therefore hardly be expected that observation should generally determine whether the supposed obscuration takes place or not.

The third argument is necessarily inconclusive, because we know not whether there is any water in the moon or not; nor, though this could be demonstrated, would it follow that the lunar atmosphere answers no other purpose than the raising of water into vapour. There is, however, a strong argument in favour of the existence of a lunar atmosphere, taken from the appearance of a luminous ring round the moon in the time of solar eclipses. In the eclipse of May 1, 1706, Captain Stanyan, from Bern in Switzerland, writes, that "the sun was totally darkened there for the space of four minutes and a half: that a fixed star and planet appeared very bright: that his getting out of the eclipse was preceded by a blood-red streak of light from his left limb, which continued not longer than six or seven seconds of time; then part of the sun's disk appeared, all on a sudden, brighter than Venus was ever seen in the night; and in that very instant gave light and shadow to things as strong as moon-light uses to do." The publisher of this account observes, that the red streak of light preceding the emersion of the sun's body, is a proof that the moon has an atmosphere; and its short continuance of five or six seconds shows that its height is not more than the five or six hundredth part of her diameter.

149 Luminous ring observed about the moon in total eclipses.

Fatio, who observed the same eclipse at Geneva, tells us, that "there was seen, during the whole time of the total immersion, a whiteness which seemed to break out from behind the moon, and to encompass her on all sides equally: this whiteness was not well defined on its outward side, and the breadth of it was not a twelfth part of the diameter of the moon. The planet appeared very black, and her disk very well defined with the whiteness which encompassed it about, and was of the same colour as that of a white crown or halo of about four or five degrees in diameter, which accompanied it, and had the moon for its centre. A little after the sun had begun to appear again, the whiteness, and the crown which had encompassed the moon did entirely vanish." "I must add (says Dr Long), that this description is a little perplexed, either through the fault of the author or of the translator; for I suppose Fatio wrote in French; however, it plainly appears by it that the moon's atmosphere was visible, surrounded by a light of larger extent, which I think must be that luminous appearance (the zodiacal light) mentioned from Cassini." Flamstead, who published this account, takes notice, that, according to these observations, the altitude of the moon's atmosphere cannot be well supposed less than 130 geographical miles; and that probably this atmosphere was never discovered before this eclipse, by reason of the smallness of the refraction, and the want of proper observations.

An account of the same eclipse as it appeared at Zurich, is given by Dr Scheuchzer, in the following words: "We had an eclipse of the sun, which was both total and annular: total, because the whole sun was covered by the moon; annular, not what is properly so called, but by refraction; for there appeared round the moon a bright shining, which was owing to the rays of the sun refracted through the atmosphere of the moon.

Dom. Cassini, from a number of accounts sent him from different parts, says, that in all those places where it was total, during the time of total darkness, there was seen round the moon a crown or broad circle of pale light, the breadth whereof was about a 12th part of the moon's diameter: that at Montpelier, where the observers were particularly attentive to see if they could distinguish the zodiacal light already mentioned, they took notice of a paler light of a larger extent, which surrounded the crown of light before mentioned, and spread itself on each side of it, to the distance of four degrees. He then mentions Kepler's opinion, that the crown of light which appears round the moon during the total darkness in an eclipse of the sun, is caused by some celestial matter surrounding the moon, of sufficient density to receive the rays of the sun and send them to us; and that the moon may have an atmosphere similar to that of our earth, which may refract the sun's light. 150

Dr Halley's account of a solar eclipse in 1715.

A total eclipse of the sun was observed on the 22d of April O. S. in the year 1715, by Dr Halley at London, and by M. Louville of the Academy of Sciences at Paris. Dr Halley relates, that "when the last part of the sun remained on his east side, it grew very faint, and was easily supportable to the naked eye even through the telescope, for above a minute of time before the total darkness; whereas, on the contrary, the eye could not endure the splendor of the emerging beams through the telescope even from the first moment. To this two causes perhaps concurred: the one, that the pupil of the eye did necessarily dilate itself during the darkness, which before had been much contracted by looking on the sun: the other, that the eastern parts of the moon, having been heated with a day near as long as 30 of ours, must of necessity have that part of its atmosphere replete with vapours raised by the so long continued action of the sun; and, by consequence, it was more dense near the moon's surface, and more capable of obstructing the sun's beams; whereas at the same time the western edge of the moon had suffered as long a night, during which there might fall in dews all the vapours that were raised in the preceding long day; and for that reason, that part of its atmosphere might be seen much more pure and transparent.

"About two minutes before the total immersion, the remaining part of the sun was reduced to a very fine horn, whose extremities seemed to loose their acuteness,

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neſs, and to become round like ſtars; and for the ſpace of about a quarter of a minute a ſmall piece of the ſouthern horn of the eclipſe ſeemed to be cut off from the reſt by a good interval, and appeared like an oblong ſtar rounded at both ends: which appearance would proceed from no other cauſe but the inequalities of the moon's ſurface: there being ſome elevated parts thereof near the moon's ſouthern pole, by whoſe interpoſition part of that exceedingly fine filament of light was intercepted. A few ſeconds before the ſun was totally hid there diſcovered itſelf round the moon a luminous ring about a digit, or perhaps a tenth part of the moon's diameter in breadth. It was of a pale whiteneſs, or rather of a pearl colour, ſeeming to me a little tinged with the colour of the iris and to be concentric with the moon; whence I concluded it the moon's atmoſphere. But the great height of it, far exceeding that of our earth's atmoſphere, and the obſervations of ſome who found the breadth of the ring to increaſe on the weſt ſide of the moon as the emerſion approached, together with the contrary ſentiments of thoſe whoſe judgments I ſhall always revere, make me leſs confident, eſpecially in a matter to which I gave not all the attention requiſite.

"Whatever it was, this ring appeared much brighter and whiter near the body of the moon than at a diſtance from it; and its outward circumference, which was ill defined, ſeemed terminated only by the extreme rarity of the matter of which it was compoſed, and in all reſpects reſembled the appearance of an enlightened atmoſphere ſeen from far: but whether it belonged to the ſun or moon, I ſhall not pretend to determine.

151 Flaſhes of light appear to dart from behind the moon.

During the whole time of the total eclipſe, I kept my teleſcope conſtantly fixed on the moon, in order to obſerve what might occur in this uncommon appearance; and I ſaw perpetual flaſhes or coruſcations of light, which ſeemed for a moment to dart out from behind the moon, now here, now there, on all ſides, but more eſpecially on the weſtern ſide, a little before the emerſion; and about two or three ſeconds before it, on the ſame weſtern ſide, where the ſun was juſt coming out, a long and very narrow ſtreak of duſky but ſtrong red light ſeemed to colour the dark edge of the moon, though nothing like it had been ſeen immediately after the immerſion. But this inſtantly vaniſhed after the appearance of the ſun, as did alſo the aforeſaid luminous ring."

152 Mr Louville's obſervations.

Mr Louville relates, that a luminous ring of a ſilver colour appeared round the moon as ſoon as the ſun was entirely covered by her diſk, and diſappeared the moment he recovered his light; that this ring was brighteſt near the moon, and grew gradually fainter towards its outer circumference, where it was, however, defined; that it was not equally bright all over, but had ſeveral breaks in it: but he makes no doubt of its being occaſioned by the moon's atmoſphere, and thinks that the breaks in it were occaſioned by the mountains of the moon: he ſays alſo, that this ring had the moon, and not the ſun, for its centre, during the whole time of its appearance. Another proof brought by him of the moon having an atmoſphere is, that, towards the end of the total darkneſs, there was ſeen on that ſide of the moon on which the ſun was going to appear, a piece of a circle of a lively red, which might be owing to the red rays that are leaſt refrangible being tranſmitted through the moon's atmoſphere in the greateſt quantity: and that he might be aſſured this redneſs did not proceed from the glaſſes of his teleſcope, he took care to bring the red part into the middle of his glaſſes.

153 Lightning ſuppoſed to be frequent in the moon.

He lays great ſtreſs on the ſtreaks of light which he ſaw dart inſtantaneouſly from different places of the moon during the time of total darkneſs, but chiefly near the eaſtern edge of the diſk: theſe he takes to be lightning, ſuch as a ſpectator would ſee flaſhing from the dark hemiſphere of the earth, if he were placed upon the moon and ſaw the earth come between himſelf and the ſun. "Now (ſays Dr Long) it is highly probable, that if a man had, at any time, a view of that half of the earth where it is night, he would ſee lightning in ſome part of it or other." Louville farther obſerves, that the moſt mountainous countries are moſt liable to tempeſts; and that mountains being more frequent in the moon, and *higher, than on earth**, thunder and lightning muſt be more frequent there than with us; and that the eaſtern ſide of the moon would be moſt ſubject to thunder and lightning, thoſe parts having been heated by the ſun for half the month immediately preceding. It muſt here be obſerved, that Halley, in mentioning theſe flaſhes, ſays they ſeemed to come from behind the moon; and Louville, though he ſays they came ſometimes from one part and ſometimes from another, owns, that he himſelf only ſaw them near the eaſtern part of the diſk; and that, not knowing at that time what it was that he ſaw, he did not take notice whether the ſame appearance was to be ſeen on the other parts of the moon or not. He tells us, however, of an Engliſh aſtronomer, who preſented the Royal Society with a draught of what he ſaw in the moon at the time of this eclipſe; from which Louville ſeems to conclude that lightnings had been obſerved by that aſtronomer near the centre of the moon's diſk. "Now (ſays Dr Long) thunder and lightning would be a demonſtration of the moon having an atmoſphere ſimilar to ours, wherein vapours and exhalations may be ſupported, and furniſh materials for clouds, ſtorms, and tempeſts. But the ſtrongeſt proof brought by Louville of the moon having an atmoſphere is this, that as ſoon as the eclipſe began, thoſe parts of the ſun which were going to be hid by the moon grew ſenſibly paliſh as the former came near them, ſuffering beforehand a kind of imperfect eclipſe or diminution of light; this could be owing to nothing elſe but the atmoſphere of the moon, the eaſtern part whereof going before her reached the ſun before the moon did.

154 Great height of the lunar atmoſphere accounted for.

As to the great height of the lunar atmoſphere, which from the breadth of the luminous ring being about a whole digit would upon a calculation come out 180 miles, above three times as high as the atmoſphere of the earth, Louville thinks that no objection; ſince, if the moon were ſurrounded with an atmoſphere of the ſame nature with that which encompaſſes the earth, the gravitation thereof towards the moon would be but one-third of that of our atmoſphere towards the earth; and conſequently its expanſion would make the height of it three times as great from the moon as is the height of our atmoſphere from the earth."

The ſame luminous ring has been obſerved in other total eclipſes, and even in ſuch as are annular, though without the luminous ſtreaks or flaſhes of lightning above-

* See n° 142 *et ſeq.*

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bovementioned; it is even taken notice of by Plutarch: however, some members of the academy at Paris have endeavoured to account for both these phenomena without having recourse to a lunar atmosphere; and for this purpose they made the following experiments.

155 These phenomena otherwise accounted for.

The image of the sun coming through a small hole into a darkened room, was received upon a circle of wood or metal of a diameter a good deal larger than that of the sun's image; then the shadow of this opaque circle was cast upon white paper, and there appeared round it, on the paper, a luminous circle such as that which surrounds the moon. The like experiment being made with a globe of wood, and with another of stone not polished, the shadows of both these cast upon paper were surrounded with a palish light, most vivid near the shadows, and gradually more diluted at a distance from them. They observe also, that the ring round the moon was seen in the eclipse of 1706 by Wurzelbaur, who cast her shadow upon white paper. The same appearance was observed on holding an opaque globe in the sun, so as to cover his whole body from the eye; for, looking at it through a smoked glass, in order to prevent the eye from being hurt by the glare of light it would otherwise be exposed to, the globe appeared surrounded with a light resembling that round the moon in a total eclipse of the sun.

Thus they solve the phenemenon of the ring seen round the moon by the inflection, or *diffraction* as they call it, of the solar rays passing near an opaque substance. As for the small streaks of light abovementioned, and which are supposed to be lightning, they explain these by an hypothesis concerning the cavities of the moon themselves; which they consider as concave mirrors reflecting the light of the sun nearly to the same point; and as these are continually changing their situation with great velocity by the moon's motion from the sun, the light which any one of them sends to our eye is seen but for a moment. This, however, will not account for the flashes, if any such there are, seen near the centre of the disk, though it does, in no very satisfactory manner, account for those at the edges.

156 Occultations of the fixed stars by the moon.

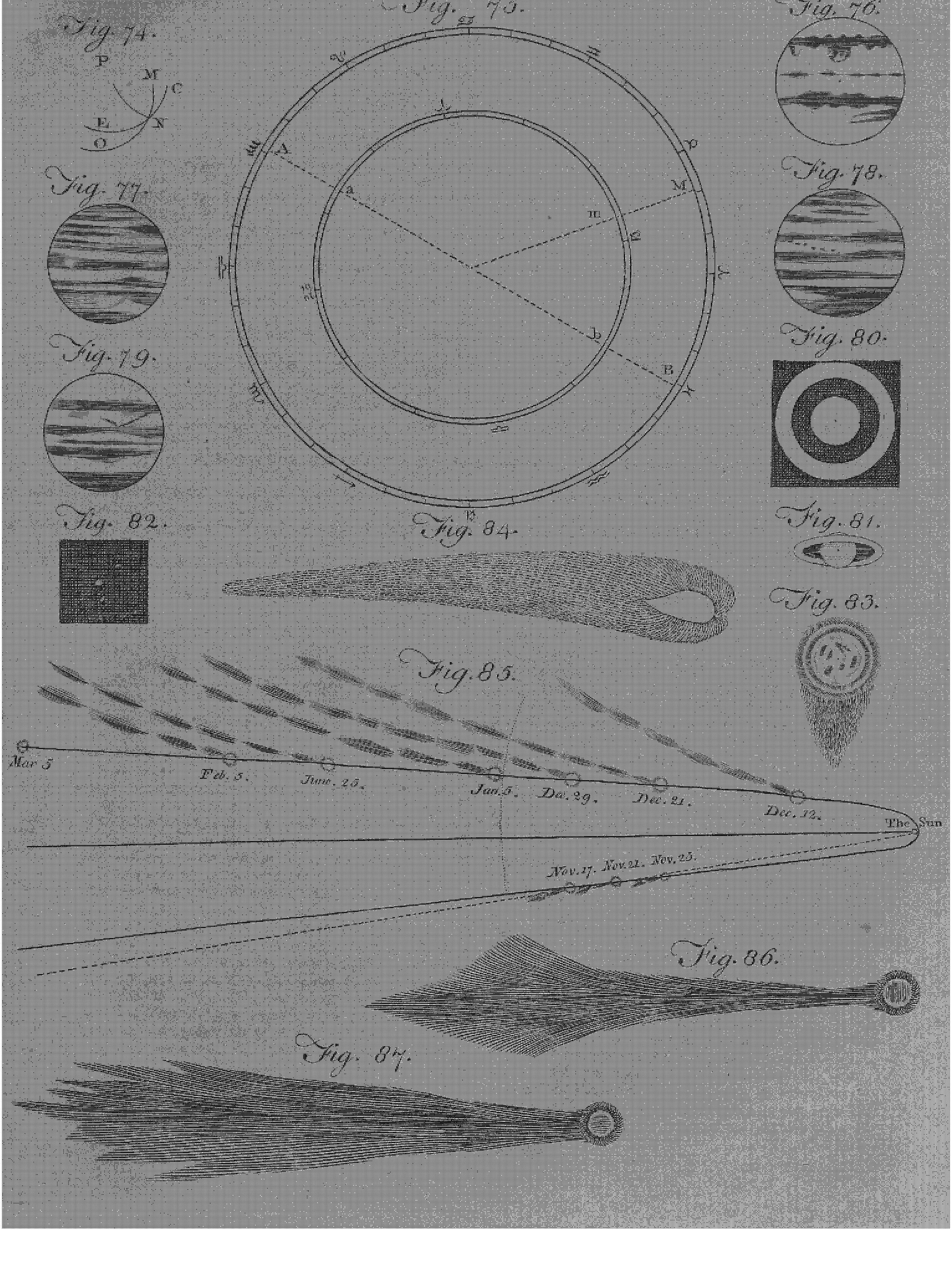
It has already been observed, that the occultations of the fixed stars and planets by the moon in general happen without any kind of refraction of their light by the lunar atmosphere. The contrary, however, has sometimes been observed, and the stars have been seen manifestly to change their shape and colour on going behind the moon's disk. An instance of this happened on the 28th of June N. S. in the year 1715, when an occultation of Venus by the moon happened in the day-time. Some astronomers in France observing this with a telescope, saw Venus change colour for about a minute before she was hid by the moon; and the same change of colour was observed immediately after her emersion from behind the disk. At both times the edge of the disk of Venus that was nearest the moon appeared reddish, and that which was most distant of a bluish, colour. These appearances, however, which might have been taken for proofs of a lunar atmosphere, were supposed to be owing to the observers having directed the axes of their telescopes towards the moon. This would necessarily cause any planet or star near the edge of the moon's disk to be seen through those parts of the glasses which are near their circumference, and consequently to appear coloured. This was evidently the case from other observations of an occultation of Jupiter by the moon the same year, when no such appearance of refraction could be perceived while he was kept in the middle of the telescope. Maraldi also informs us, that he had observed before this two other occultations of Venus and one of Jupiter; and was always attentive to see whether those planets changed their figure or colour either upon the approach of the moon to cover them, or at their first coming again into sight; but never could perceive any such thing. Nor could he, in a great number of occultations of the fixed stars, perceive the smallest apparent change in any of them, excepting once that a fixed star seemed to increase its distance a little from the moon as it was going to be covered by her; but this, he suspected, might be owing to his telescope being directed so as to have the star seen too far from the middle of its aperture. He concludes, therefore, that the moon has no atmosphere: and he remarks, that at Montpelier, perhaps because the air is clearer there than at London, the luminous ring round the moon appeared much larger than at London; that it was very white near the moon, and gradually decreasing in brightness formed round her a circular area of about eight degrees in diameter. If, says he, this light was caused by the atmosphere of the moon, of what a prodigious extent must that atmosphere be?

157 Of a plurality of worlds.

Before we enter upon any further speculations concerning the celestial bodies, we shall here take some notice of the doctrine of a plurality of worlds; to which we are naturally led by the question, Whether the moon is inhabited or not? This is an hypothesis of very ancient date, and which in modern times has been revived in such a manner as now to be almost adopted as an undoubted truth. Plutarch, Diogenes, Laertius, and Stobæus, informs us, that this doctrine was embraced by several of the ancient Greek philosophers; from which authors Gregory has given us extracts in the Preface to his Astronomy. "Among the moderns (says Dr Long), Huygens has written a treatise, which he calls *Cosmotheoros*, or *A view of the world*, worth perusing. One thing, however, I must find fault with; that, in peopling the planets with reasonable creatures, he insists upon their being in all points exactly similar to the human race, as to the shape of their bodies and the endowments of their minds: this is too confined a thought; for we cannot but acknowledge that infinite power and wisdom is able to form rational beings of various kinds, not only in shape and figure different from the human, but endowed also with faculties and senses very different; such as in our present state we can have no idea of." With regard to the probability of the doctrine itself, the Doctor expresses himself in the following manner. "That the earth and all the creatures thereon were created to be subservient to the use of man, we may believe upon the authority of the sacred writer, Psalm viii. but that the stars and planets were formed only to bespangle the canopy of heaven with their glimmering, which does not furnish us with the twentieth part of the light the moon gives, I think is not at all probable: this is contrary to the observation made by the best philosophers, that nature is magnificent in all her designs, but frugal in the execution of them. It is commonly said, that nature

ASTRONOMY.

Plate LXVIII



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nature does nothing in vain: now by *Nature*, in a sound sense, must be understood the present order and disposition of things according to the will of the supreme Being."

158 Objections to the possibility of this doctrine.

Objections have been made to the possibility of this hypothesis from the different degrees of heat and light which the planets receive from the sun, according to their various distances from him. On Venus, for instance, the heat must be more than double what it is with us, and on Mercury upwards of ten times as great; so that were our earth brought as near the sun as Mercury, every drop of liquid would be evaporated into steam, and every combustible solid set on fire; while, on the other hand, were we removed to the distance of the superior planets, such as the Georgium Sidus, Saturn, or even Jupiter, there is the highest probability that our liquids would all be congealed into ice, at the same time that the climate would be utterly insupportable by such creatures as we are. Objections of the same kind are drawn from the small quantity of light which falls upon the more distant planets, which

160 Inconclusive.

it is thought would be insufficient for the purposes of living and rational creatures. Such arguments as these, however, are by no means conclusive; for as Dr Long justly observes, "we are sure, that if the all-wise supreme Being hath placed animals on the planets, he has fitted the inhabitants to the places, and the places to the inhabitants." We shall therefore only add the following quotation from Mr Nicholson † concerning final causes, which sums up all that can be said with propriety in favour of the doctrine in question.—"The purposes or motives (says he) which determine the actions of intelligent beings, and produce their effects in a manner similar to the operation of the laws of nature, or the properties of matter in cases where thought is not supposed to concerned, are called *final causes*. In the works of nature we behold enough of exquisite contrivance, and can see far enough into many final causes, to convince us that the arrangement of the universe has been made, and probably still is occasionally adjusted, by a Being whose intelligence and power are immensely beyond what we possess. To judge properly of his intentions, or, in other words, to be equal to the task of exploring final causes, requires no less than a perfect knowledge and recollection of every purpose to which the objects around us may be applied, together with a clear conception of the ideas of fitness and order that form the prototypes in the mind of that Great Being who directs their motions. These considerations show the absurdity of attempting to explain the final causes of every event we see; but they by no means require that we should neglect them in cases where we have reason to believe that we understand the phenomena, and have sufficient experience to be assured that we discern the principal, or at least one of the principal, purposes to which things may have been destined. Thus it is scarcely to be imagined that we can err in concluding, that the eyes, ears, legs, wings, and other parts of animals were made for the purposes of seeing, hearing, walking, flying, and so forth. Neither can we avoid inferring, that the Power who constructed living creatures with mouths, teeth, and organs to digest and assimilate food for their nutriment, did likewise form other organized bodies, which we call *vegetables*, for the express purpose of affording that food. It is needless to multiply instances. We cannot avoid seeing them every moment; and their effect is so striking, that we are insensibly forced from analogy to allow the existence of a final cause in all cases, whether we are able to discover it or not.

† *Introd. to Nat. Phil.* page 141. Philad. Edition.

161 Of the various climates of the planets.

"On this ground, an inquiry into the final causes of the planetary bodies offers itself to our consideration. The earth is shown to be a planet in circumstances very similar to the other five: we know its final cause—to support a number of inhabitants: And by analogy we may conclude that the others are also habitable worlds; though, from their different proportions of heat, it is credible that beings of our make and temperature could not live upon them. However, even that can scarcely be affirmed of all the planets; for the warmest climate on the planet Mars is not colder than many parts of Norway or Lapland are in the spring or autumn. Jupiter, Saturn, and the Georgium Sidus, it must be granted, are colder than any of the inhabited parts of our globe. The greatest heat on the planet Venus exceeds the heat on the island of St Thomas on the coast of Guinea, or Sumatra in the East Indies, about as much as the heat in those places exceeds that of the Orkney islands, or the city of Stockholm in Sweden: therefore, at 60° north latitude on that planet, if its axis were perpendicular to the plane of its orbit, the heat would not exceed the greatest heat on the earth; and of course vegetation like ours might be there carried on, and animals of the species on earth might subsist. If Mercury's axis be supposed to have a like position, a circle of about 20° diameter round each pole would enjoy the same temperature as the warmer regions of the earth, though in its hottest climate water would continually boil, and most inflammable substances would be parched up, destroyed, or converted into vapour. But it is not at all necessary that the planets should be peopled with animals like those on the earth; the Creator has doubtless adapted the inhabitants of each to their situation.

162 Comparison of the light of the superior planets with our day.

"From the observations that have been just made, a better idea may be formed of the proportions of heat on the planets than can be conveyed by numbers. It will not, however, be remote from our purpose to compare the light of the superior planets with that of our day; from whence it will appear, that they are by no means in a state of darkness notwithstanding their great distance from the sun. This might be instanced by several different methods; as by the sun's light admitted into a dark chamber, and received on paper with different degrees of obliquity; by a greater or less number of candles brought into a room for the purpose of illuminating it with various degrees of light; or by various optical methods that need not here be described. It will be sufficient for the illustration of the subject to compare their different proportions of light with that of a moonshine night at the time of full.

"When the moon is visible in the day-time, its light is so nearly equal to that of the lighter thin clouds, that it is with difficulty distinguished among them. Its light continues the same during the night; but the absence of the sun suffering the pupil of the eye to dilate itself, it become more conspicuous. It therefore follows, that if every part of the sky were equally

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equally luminous with the moon's diſk, the light would be the ſame as if in the day-time it were covered with the thin clouds abovementioned. This day-light is conſequently in proportion to that of the moon as the whole ſurface of the ſky or viſible hemiſphere is to the ſurface of the moon; that is to ſay, nearly as 90,000 to 1. The light of the Georgium Sidus being to that of the earth as 0.276 to 100, will be equal to the effect of 248 full moons. Jupiter's day will equal the light of 3,330 moons; and that of Mars will require 38,700, a number ſo great that they would almoſt touch one another. It is even probable, that the comets in the moſt diſtant parts of their orbits enjoy a degree of light much exceeding moonſhine."

Of all the celeſtial bodies, comets have given riſe to the greateſt number of ſpeculations and conjectures. Their ſtrange appearance has in all ages been a matter of terror to the vulgar, who uniformly have looked upon them to be evil omens and forerunners of war, peſtilence, &c. Others, leſs ſuperſtitious, ſuppoſed them to be meteors raiſed in the higher regions of the air. But we find that ſome part of the modern doctrine concerning them had been received into the ancient Italic and Pythagorean ſchools: for they held them to be ſo far of the nature of planets, that they had their periodical times of appearing; that they were out of ſight for a long time, while they were carried aloft at an immenſe diſtance from the earth, but become viſible when they deſcended into the lower regions of the air, when they were nearer to us.

163
Suppoſed by the ancients to be planets.

Theſe opinions were probably brought from Egypt, from whence the Greeks borrowed great part of their learning. However, it ſeems not to have been generally received; for Ariſtotle, who mentions it, aſſerted that the heavens were unchangeable, and not liable to generation or corruption. Comets, therefore, which he believed to be generated when they firſt made their appearance, and deſtroyed when they vaniſhed from our ſight, he maintained could not be heavenly bodies, but rather meteors or exhalations raiſed into the upper regions of the atmoſphere, where they blazed out for a while, and diſappeared when the matter of which they were formed was conſumed. Seneca, who lived in the firſt century, mentions Appollonius of Myndus, a very careful obſerver of natural cauſes, to have been of the ſame ſentiments with the moſt ancient Greek philoſophers with regard to comets. He himſelf had ſeen two; one in the reign of Claudius, the other in that of Nero; beſides another which he ſaw while a boy, before the death of Auguſtus. He plainly intimates, that he thought them above the moon; and argues ſtrongly againſt thoſe who ſuppoſed them to be meteors, or held other abſurd opinions concerning them; declaring his belief that they were not fires ſuddenly kindled, but the eternal productions of nature. He points out alſo the only way to come at a certainty on this ſubject, viz. by collecting a number of obſervations concerning their appearance, in order to diſcover whether they return periodically or not. "For this purpoſe (ſays he) one age is not ſufficient; but the time will come when the nature of comets and their magnitudes will be demonſtrated, and the routs they take, ſo different from the planets, explained. Poſterity will then wonder that the preceding ages ſhould be ignorant of matters ſo plain and eaſy to be known."

164
Ariſtotle's opinion concerning them.

For a long time this prediction of Seneca ſeemed very unlikely to be fulfilled. The great authority which Ariſtotle maintained for many ages, determined them to be nothing but meteors caſually lighted up in the air; though they were manifeſtly at a great height, not only above the clouds, but ſubject to the diurnal revolution of the earth. In the dark and ſuperſtitious ages, they were held to be the forerunners of every kind of calamity, and were ſuppoſed to have different degrees of malignity according to the ſhape they aſſumed; from whence alſo they were differently denominated. Thus, ſome were ſaid to be bearded, ſome hairy; ſome to repreſent a beam, ſword, or ſpear; others a target, &c.; whereas modern aſtronomers acknowledge only one ſpecies of comets, and account for their different appearances from their different ſituations from the ſun and earth.

165
Only one ſpecies of them exiſts.

166
Kepler and Bodin's opinion of them.

It was not till ſome time after people began to throw off the fetters of ſuperſtition and ignorance which had ſo long held them, that any rational hypotheſis was formed concerning comets. Kepler, in other reſpects a very great genius, indulged the moſt extravagant conjectures, not only concerning comets, but the whole ſyſtem of nature in general. The planets he imagined to be huge animals who ſwam round the ſun by means of certain fins acting upon the ethereal fluid, as thoſe of fiſhes do on the water: and agreeable to this notion, he imagined the comets to be monſtrous and uncommon animals generated in the celeſtial ſpaces; and he explained how the air engendered them by an animal faculty. A yet more ridiculous opinion, if poſſible, was that of John Bodin, a learned man of France in the 16th century. He maintained that comets "are ſpirits, which having lived on the earth innumerable ages, and being at laſt arrived on the confines of death, celebrate their laſt triumph, or are recalled to the firmament like ſhining ſtars! This is followed by famine, plague, &c. becauſe the cities and people deſtroy the governors and chiefs who appeaſe the wrath of God." This opinion he ſays he borrowed from the philoſopher Democritus, who imagined them to be the ſouls of famous heroes: but that being irreconcileable with Bodin's Chriſtian ſentiments, he was obliged to ſuppoſe them to be a kind of genii, or ſpirits ſubject to death, like thoſe ſo much mentioned in the Mahometan fables. Others, again, have denied even the exiſtence of comets, and maintained that they were only falſe appearances occaſioned by the refraction or reflection of light.

167
Bernouilli's opinion.

The firſt rational conjecture we meet with is that of James Bernouilli, an Italian aſtronomer, who imagined them to be the ſatellites of ſome very diſtant planet, which was inviſible to us on account of its diſtance, as were alſo the ſatellites unleſs when in a certain part of their courſe.

168
True doctrine concerning them revived by Tycho Brache.

Tycho Brache was the firſt who reſtored the comets to their true rank in the creation. Before his time, ſeveral comets had been obſerved with tolerable exactneſs by Regiomontanus, Appian, Fabricius, and others; yet they all thought them below the moon. But Tycho, being provided with much better inſtruments ſet himſelf with great diligence to obſerve the famous

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famous comet of 1577: and from many careful observations, deduced that it had no sensible diurnal parallax; and therefore was not only far above the regions of our atmosphere, but much higher than the moon. But though few have come so near the earth as to have any diurnal parallax, all of them have what may be called an annual parallax; that is, the revolution of the earth in her orbit causes their apparent motion to be very different from what it would be if viewed from the sun; and this shows them to be much nearer than the fixed stars, which have no such parallax. Kepler, the disciple of Tycho, notwithstanding his ridiculous conjecture already mentioned, was very attentive to the motions of the comets, and found that they did not move in straight lines, as had been supposed. He showed that their paths were concave towards the sun, and supposed them to move in parabolic trajectories.

169 Their motion exactly determined by Sir Isaac Newton.

Their true motion, however, was only discovered from the observations made by Sir Isaac Newton on the great comet of 1680. This descended almost perpendicularly towards the sun with a prodigious velocity; ascending again with the same velocity retarded, as it had been before accelerated. It was seen in the morning by a great number of astronomers in different parts of Europe, from the 4th to the 25th of November, in its way towards the sun; and in the evening from the 12th of December to the 9th of March following. The many exact observations made on this comet, enabled Sir Isaac Newton to determine that they are a kind of planets which move in very eccentric ellipsis; and this opinion is now looked upon to be certainly established. It was opposed, however, by M. de la Hire, and some other French philosophers; and it is evident that the whole dispute now turned on mere practical observation. If the return of any comet could be predicted, and its periodical time calculated like that of a planet, then the doctrine might be concluded certainly true, but not otherwise.

170 Dr Halley predicts a comet's return.

Dr Halley therefore set himself to collect all the observations he could on comets; and afterwards calculated the orbits of twenty-four of them, on a supposition of their being paraboles; but afterwards found that they agreed better with the supposition of their motion being performed in very eccentric elliptical orbits. On this he calculated a table of their elements; from which it was manifest that they were not comprehended in the zodiac, some of them making an angle of upwards of 80° with the ecliptic.

171 Periodical times of different comets determined.

By computations founded on these elements, the Doctor concluded that the comet of 1682, was the same which had appeared in 1607 and 1531; that it had a period of 75 or 76 years; and he ventured to foretel that it would return about the year 1758. The comet which appeared in 1661 was supposed to be the same with that of 1532, and to have a period of 129 years; and from the equality of periods, and similitude of appearances, it was concluded that the great comet of 1680 was the same which had appeared in 1106 in the time of Henry I. and the consulate of Lampadius and Orestes about the year 531, and in the year 44 B. C. before Julius Cæsar was murdered; and thence concluded that its period was 575 years. Mr Dunthorne, however, has endeavoured to show from a MS. in Pembroke-hall library, that the comet of 1106 could not be the same with that of 1680; but M. de la Lande thinks the four appearances related by Dr Halley stronger proofs than a single observation, which might be very faulty.

Since the time of Dr Halley other astronomers have calculated the elements of 25 other comets: all of which, excepting one of three which appeared in 1759, and which differs but little from that of 1531, 1607, and 1682, and is therefore accounted the same; differ very much from each other; so that we cannot help concluding them all to be different, and that the number of these bodies is very great.

172 Why comets may sometimes be invisible even in their perihelion.

"It is not, however, unlikely (says Dr Long), from the immense interval between the orbit of Saturn and the nearest fixed stars, that many of them have not descended into the planetary regions since they have been looked upon as celestial bodies, and observed accordingly; besides, it may often happen, that a body may finish its whole period without being observed by us, on account of the unfavourable situation of the earth in her orbit when the comet is in its perihelion. Thus, if the comet be either behind or before the sun, or nearly so, it must be above our horizon in the day-time, and consequently invisible, except the sun should at that time be in a total eclipse; for then the comet might be seen near the sun, as well as the stars and planets are: and this case is said to have happened; for Seneca relates from Possidonius, that a comet was seen when the sun was eclipsed, which had before been invisible by being near that luminary."

173 Why more are seen in the hemisphere towards the sun than in the opposite.

A greater number of comets are seen in the hemisphere towards the sun than in the opposite; the reason of which will easily appear from fig. 97. wherein S represents the sun, E the earth, ABCD the sphere of the fixed stars: and because comets either do not reflect the light enough to be visible, or emit tails conspicuous enough to attract our notice, till they come within the planetary regions, commonly a good way within the sphere of Jupiter, let KLMN be a sphere concentric to the sun, at such a distance from him, that no comet can be seen by us till it come within that distance; through E draw the plane BD perpendicular to SE, which will divide the sphere KLMN into two hemispheres, one of which BCD, is towards the sun, the other, DAB, opposite. Now it is manifest, that the spherical portion LMN, which is in the hemisphere BCD towards the sun, is larger than the portion NKL in the hemisphere opposite to him; and consequently a greater number of comets will appear in the hemisphere BCD than in that marked DAB.

174 Great differences in the eccentricities of the orbits of comets.

Though the orbits of all comets are very eccentric ellipses, there are vast differences among them; but excepting Mercury, there are no great differences among the planets either as to the eccentricity of their orbits, or the inclination of their planes; the planes of some comets are almost perpendicular to others, and some of their ellipses are much wider than others. The narrowest ellipsis of any comet hitherto observed was that of 1680. There is also a much greater inequality in the motion of the comets than of the planets; the velocity of the former being incomparably greater in their perihelion than in their aphelion; but the planets are but very little accelerated.

175 Opinions concerning their substance.

Astronomers are now generally agreed, that comets are opaque bodies, enlightened by the sun. Hevelius, in a large work, wherein he gives the opinion of various

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ous authors on the subject, mentions some who were of the same sentiments with himself, that comets were so far transparent as to let the light of the sun pass through them, which formed their tails. Sir Isaac Newton was of opinion, that they are quite opaque; and in confirmation of this, he observes, that if a comet be seen in two parts of its orbit, at equal distances from the earth, but at unequal distances from the sun, it always shines brightest in that nearest the sun. They are of very different magnitudes, which may be conjectured from their apparent diameter and brightness. Thus the head of a comet, when of the same brightness and apparent diameter with Saturn, may be supposed to be nearly about the same magnitude with that planet; though this must be attended with some uncertainty, as we know not whether the heads of comets reflect the sun's light in the same manner the planets do. Their distance may be known from their parallax, in the manner related in a subsequent section.

176 Distances, diameters, &c. of some comets computed.

In this manner he found the distance of the comet of 1577 to be about 210 semidiameters of the earth, or about 840,000 miles distant from us, its apparent diameter being seven minutes; whence he concluded, that the true diameter of the comet was to that of the earth as 3 to 14. "But (says Dr Long) it was the atmosphere of the comet which was then measured." Hevelius, from the parallax and apparent diameter of the head of the comet in 1652, computed its diameter to be to that of the earth as 52 to 100. By the same method he found the diameter of the head of the comet of 1664 to be at one time 12 semidiameters of the earth, and at another not much more than 5. "That the head of a comet must appear less the farther it is from the earth (says Dr Long) is obvious; but besides this apparent change, there is also a real one in the dimensions of the head of the same comet; for, when near the sun, the atmosphere is diminished by the heat raising more of it into the tail; whereas, at a greater distance, the tail is diminished and the head enlarged." Hevelius computed the diameter of the nucleus of the comets of 1661 and 1665 to be only about a tenth part of that of the earth; and Cysatus makes the true diameter of the comet of 1618 to be about the same size. Some comets, however, from their apparent magnitude and distance, have been supposed much larger than the moon, or even equal in magnitude to some of the primary planets; and some

177 Eclipses occasioned by comets.

have imagined, that by an interposition of these bodies betwixt the earth and sun, we might account for those darknesses which cannot be derived from any interposition of the moon. Such are those mentioned by Herodotus, l. 7. c. 37. and l. 9. c. 70. likewise the eclipse mentioned by Dion, which happened a little before the death of Augustus; and it is observable that Seneca saw a comet that year. Some have even attempted to account in this manner for the darkness which happened at our Saviour's crucifixion; and indeed it is certain, that were a comet in its perigee to come between the earth and sun, and to be moving the same way with the earth, it must cause a darkness much more intense, as well as of more considerable duration, than what could take place in any lunar eclipse.

178 Conjectures concerning their tails.

Various conjectures have been formed respecting the tails of comets; though it is acknowledged by all, that they depend on the sun somehow or other; and for this plain reason, that they are always turned from him; but in what manner this is accomplished, we cannot easily determine. Apian, Tycho-Brache, and others, thought the tail was formed by the sun's rays transmitted through the nucleus of the comet, which they fancied transparent, and was there refracted as in a lens of glass, so as to form a beam of light behind the comet: but this cannot be the case, as well because the figure of a comet's tail does not answer to such a refraction, as that such refracted light would not be seen by a spectator placed sideways to it, unless it fell upon some substance sufficiently dense to cause a reflexion. 179

179 Opinion of Des Cartes.

Des Cartes and his followers were of opinion, that the tail of a comet was owing to the refraction of its head: but if this were the case, the planets and principal fixed stars must have tails also; for the rays from them pass through the same medium as the light from the comets. Sir Isaac Newton was of opinion, that the tail of a comet is a very thin vapour which the head sends out by reason of its heat: that it ascends from the sun just as smoke does from the earth: that as the ascent of smoke is caused by the rarefaction of the air wherein it is entangled, causing such air to ascend and carry the smoke up with it; so the sun's rays acting upon the coma or atmosphere of the comet, do by rarefaction and refraction heat the same; that this heated atmosphere heats, and by heating rarefies, the ether that is involved therein; and that the specific gravity with which such ether tends to the sun, is so diminished by its rarefaction, that will now ascend from him by its relative lightness, and carry with it the reflecting particles whereof the tail is composed. Tho' the immensely large tails of some comets seem to require a great quantity of matter to produce them, this is no objection to the foregoing solution: for every day's experience shows what a great quantity of smoke is produced from a very little wood or coal; and Newton has demonstrated, that a cubic inch of air equally rarefied with that at the distance of a semidiameter from the earth's surface, would fill all the planetary regions to the orbit of Saturn and beyond. Mairan entertained a very different opinion. He supposed the tails of the comets to be formed out of the luminous matter whereof the sun's atmosphere consists. This he supposes to extend as far as the orbit of the earth, and to furnish matter for the aurora borealis. M. de la Lande is for joining the two last opinions together. Part of the matter which forms the tails of comets he supposes to arise from their own atmosphere rarefied by heat and pushed forward by the force of the light streaming from the sun; and also that a comet passing through the sun's atmosphere is drenched therein, and carries away some of it. Mr Rowning objects to Newton's account, that it can hardly be supposed the thin vapour of the tail should go before the more solid body of the comet, when the motion thereof is sometimes so extremely swift, as that of some of the comets is said to be after the rate, as Sir Isaac Newton calculated the motion of the comet of 1680 to be, of no less than 880,000 miles an hour. He therefore supposes the atmosphere of the comet to extend every way round it as far as the tail reaches; and that the part of it which makes the tail is distinguished from the rest, so as to fall thick upon that part of the atmosphere which goes before the comet in its progress along its elliptic orbit.

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The greatest objection to this is the immense magnitude of the atmospheres; as it must now be supposed to account for the vast lengths of the tails of some comets, which have been said to measure above 80 millions of miles.

The many discoveries which, since the time of Newton, Halley, and other celebrated mathematicians, have been made in electricity, having brought in a new element unknown to former ages, and which shows a vast power through every part of the creation with which we are acquainted, it became natural to imagine that it must extend also into those higher regions which are altogether inaccessible to man. The similarity of the tails of comets to the aurora borealis, which is commonly looked upon to be an electrical phenomenon, therefore suggested an opinion at present far from being generally disbelieved, that the tails of comets are streams of electric matter. An hypothesis of this kind was published by Dr Hamilton of Dublin in a small treatise, entitled, *Conjectures on the Nature of the Aurora Borealis, and on the Tails of Comets.* His hypothesis is, that the comets are of use to bring back the electric fluid to the planets, which is continually discharged from the higher regions of their atmospheres. Having given at length the abovementioned opinion of Sir Isaac, "We find (says he) in this account, that Sir Isaac ascribes the ascent of comets tails to their being rarer and lighter, and moving round the sun more swiftly, than the solar atmosphere, with which he supposes them to be surrounded whilst in the neighbourhood of the sun; he says also, that whatever position (in respect to each other) the head and tail of a comet then receive, they will keep the same afterwards most freely; and in another place he observes, 'That the celestial spaces must be entirely void of any power of resisting, since not only the solid bodies of the planets and comets, but even the exceeding thin vapours of which comets tails are formed, move thro' those spaces with immense velocity, and yet with the greatest freedom.' I cannot help thinking that this account is liable to many difficulties and objections, and that it seems not very consistent with itself or with the phenomena.

180
Dr Hamilton of Dublin's opinion.

"I do not know that we have any proof of the existence of a solar atmosphere of any considerable extent, nor are we any where taught how to guess at the limits of it. It is evident that the existence of such an atmosphere cannot be proved merely by the ascent of comets tails from the sun, as that phenomenon may possibly arise from some other cause. However, let us suppose for the present, that the ascent of comets tails is owing to an atmosphere surrounding the sun, and see how the effects arising from thence will agree with the phenomena. When a comet comes into the solar atmosphere, and is then descending almost directly to the sun, if the vapours which compose the tail are raised up from it by the superior density and weight of that atmosphere, they must rise into those parts that the comet has left, and therefore at that time they may appear in a direction opposite to the sun. But as soon as the comet comes near the sun, and moves in a direction nearly at right angles with the direction of its tail, the vapours which then arise, partaking of the great velocity of the comet, and being specifically lighter than the medium in which they move, and being vastly expanded through it, must necessarily suffer a resistance immensely greater than what the small and dense body of the comet meets with, and consequently cannot possibly keep up with it, but must be left behind, or, as it were, driven backwards by the resistance of that medium into a line directed towards the parts which the comet has left, and therefore can no longer appear in a direction opposite to the sun. And, in like manner, when a comet passes its perihelion, and begins to ascend from the sun, it certainly ought to appear ever after with its tail behind it, or in a direction pointed towards the sun; for if the tail of the comet be specifically lighter than the medium in which it moves with so great velocity, it must be just as impossible it should move foremost, as it is that a torch moved swiftly thro' the air should project its flame and smoke before it. Since therefore we find that the tail of a comet, even when it is ascending from the sun, moves foremost, and appears in a direction nearly opposite to the sun, I think we must conclude that the comet and its tail do not move in a medium heavier and denser than the matter of which the tail consists, and consequently that the constant ascent of the tail from the sun must be owing to some other cause. For that the solar atmosphere should have density and weight sufficient to raise up the vapours of a comet from the sun, and yet not be able to give any sensible resistence to these vapours in their rapid progress through it, are two things inconsistent with each other: And therefore, since the tail of a comet is found to move as freely as the body does, we ought rather to conclude, that the celestial spaces are void of all resisting matter, than that they are filled with a solar atmosphere, be it ever so rare.

"But there is, I think, a further consideration, which will show that the received opinion, as to the ascent of comets tails, is not agreeable to the phenomena, and may at the same time lead us to some knowledge of the matter of which these tails consist; which I suspect is of a very different nature from what it has been hitherto supposed to be. Sir Isaac says, the vapours, of which the tail of a comet consists, grow hot by reflecting the rays of the sun, and thereby warm and rarefy the medium which surrounds them; which must therefore ascend from the sun, and carry with it the reflecting particles of which the tail is formed; for he always speaks of the tail as shining by reflected light. But one would rather imagine, from the phenomena, that the matter which forms a comet's tail has not the least sensible power of reflecting the rays of light. For it appears from Sir Isaac's observation, which I have quoted already, that the light of the smallest stars, coming to us through the immense thickness of a comet's tail, does not suffer the least diminution. And yet, if the tail can reflect the light of the sun so copiously as it must do if its great splendor be owing to such reflection, it must undoubtedly have the same effect on the light of the stars; that is, it must reflect back the light which comes from the stars behind it, and by so doing must intercept them from our sight, considering its vast thickness, and how exceedingly slender a ray is that comes from a small star; or if it did not intercept their whole light, it must at least increase their twinkling. But we do not find that it has even this small effect: for those stars that appear through the tail are not observed to twinkle more than others

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others in their neighbourhood. Since therefore this fact is supported by observations, what can be a plainer proof that the matter of a comet's tail has no power of reflecting the rays of light? and consequently that it must be a self-shining substance. But the same thing will further appear, from considering that bodies reflect and refract light by one and the same power; and therefore if comets tails want the power of refracting the rays of light, they must also want the power of reflecting them. Now, that they want this refracting power appears from hence: If that great column of transparent matter which forms a comet's tail, and moves either in a vacuum or in some medium of a different density from its own, had any power of refracting a ray of light coming through it from a star to us, that ray must be turned far out of its way in passing over the great distance between the comet and the earth; and therefore we should very sensibly perceive the smallest refraction that the light of the stars might suffer in passing through a comet's tail. The consequence of such a refraction must be very remarkable: the stars that lie near the tail would, in some cases, appear double; for they would appear in their proper places by their direct rays, and we should see their images behind the tail, by means of their rays which it might refract to our eyes; and those stars that were really behind the tail would disappear in some situations, their rays being turned aside from us by refraction. In short, it is easy to imagine what strange alterations would be made in the apparent places of the fixed stars by the tails of comets, if they had a power of refracting their light, which could not fail to be taken notice of if any such ever happened. But since astronomers have not mentioned any such apparent changes of place among the stars, I take it for granted that the stars seen through all parts of a comet's tail appear in their proper places, and with their usual colours; and consequently I infer, that the rays of light suffer no refraction in passing through a comet's tail. And thence I conclude (as before), that the matter of a comet's tail has not the power of refracting or reflecting the rays of light, and must therefore be a lucid or self-shining substance."

181 Sir Isaac's account defended.

But whatever probability the Doctor's conjecture concerning the materials whereof the tails are formed may have in it, his criticism on Sir Isaac Newton's account of them seems not to be just: for that great philosopher supposes the comets to have an atmosphere peculiar to themselves; and consequently, in their nearest approaches to the sun, both comet and atmosphere are immersed in the atmosphere of that luminary. In this case, the atmosphere of the comet being prodigiously heated on the side next to the sun, and consequently the equilibrium in it broken, the denser parts will continually pour in from the regions farthest from the sun; for the same reason, the more rarefied part which is before will continually fly off opposite to the sun, being displaced by that which comes from behind; for tho' we must suppose the comet and its atmosphere to be heated on all sides to an extreme degree, yet still that part which is farthest from the sun will be less hot, and consequently more dense, than what is nearest to his body. The consequence of this is, that there must be a constant stream of dense atmosphere descending towards the sun, and another stream of rarefied vapours and atmosphere ascending on the contrary side; just as, in a common fire, there is a constant stream of dense air descending, which pushes up another of rarefied air, flame, and smoke. The resistance of the solar atmosphere may indeed be very well supposed to occasion the curvature observable in the tails of comets, and their being better defined in the fore part than behind; and this appearance we think Dr Hamilton's hypothesis is incapable of solving. We grant, that there is the utmost probability that the tails of comets are streams of electric matter; but they who advance a theory of any kind ought to solve every phenomenon, otherwise their theory is insufficient. It was incumbent on Dr Hamilton, therefore, to have explained how this stream of electric matter comes to be bent into a curve; and also why it is better defined and brighter on the outer side of the arch than on the inner. This, indeed, he attempts in the following manner: "But that this curvature was not owing to any resisting matter appears from hence, that the tail must be bent into a curve though it met with no resistance; for it could not be a right line, unless all its particles were projected in parallel directions, and with the same velocity, and unless the comet moved uniformly in a right line. But the comet moves in a curve, and each part of the tail is projected in a direction opposite to the sun, and at the same time partakes of the motion of the comet; so that the different parts of the tail must move on in lines which diverge from each other; and a line drawn from the head of a comet to the extremity of the tail, will be parallel to a line drawn from the sun to the place where the comet was when that part of the tail began to ascend, as Sir Isaac observes; and so all the chords or lines drawn from the head of the comet to the intermediate parts of the tail, will be respectively parallel to lines drawn from the sun to the places where the comet was when these parts of the tail began to ascend. And therefore, since these chords of the tail will be of different lengths, and parallel to different lines, they must make different angles, with a great circle passing through the sun and comet, and consequently a line passing through their extremities will be a curve.

182 Dr Hamilton's hypothesis insufficient.

"It is observed, that the convex side of the tail which is turned from the sun is better defined, and shines a little brighter, than the concave side. Sir Isaac accounts for this, by saying, that the vapour on the convex side is fresher (that is, has ascended later) than that on the concave side; and yet I cannot see how the particles on the convex side can be thought to have ascended later than those on the concave side which may be nearer to the head of the comet. I think it rather looks as if the tail, in its rapid motion, met with some slight resistance just sufficient to cause a small condensation in that side of it which moves foremost, and which would occasion it to appear a little brighter and better defined than the other side; which slight resistance may arise from that subtile ether which is supposed to be dispersed through the celestial regions, or from this very electric matter dispersed in the same manner, if it be different from the ether."

On the last part of this observation we must remark, that though a slight resistance in the etherial medium would have served Sir Isaac Newton's turn, it will by no means serve Dr Hamilton's; for though a stream of

water

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water or air may be easily destroyed or broken by resistance, yet a stream of electric matter seems to set every obstacle at defiance. If a sharp needle is placed on the conductor of an electric machine, and the machine set in motion, we will perceive a small stream of electric matter issuing from the point; but though we blow against this stream of fire with the utmost violence, it is impossible either to move it, or to brighten it on the side against which we blow. If the celestial spaces then are full of a subtile ether capable of thus affecting a stream of electric matter, we may be sure that it also will resist very violently: and we are then as much difficulted to account for the projectile motion continuing amidst such violent resistance; for if the ether resists the tail of the comet, it is impossible to prove that it doth not resist the head also.

183 Electric matter not always passive.

This objection may appear to some to be but weakly founded, as we perceive the electric fluid to be endowed with such extreme subtility, and to yield to the impression of solid bodies with such facility, that we easily imagine it to be of a very passive nature in all cases. But it is certain, that this fluid only shows itself passive where it passes from one body into another, which it seems very much inclined to do of itself. It will be also found, on proper examination of all the phenomena, that the only way we can manage the electric fluid at all is by allowing it to direct its own motions. In all cases where we ourselves attempt to assume the government of it, it shows itself the most untractable and stubborn being in nature. But these things come more properly under the article Electricity, where they are fully considered. Here it is sufficient to observe, that a stream of electric matter resists air, and from the phenomena of electric repulsion we are sure that one stream of electric matter resists another; from which we may be also certain, that if a stream of electric matter moves in an aerial fluid, such fluid will resist it: and we can only judge of the degree of resistance it meets with in the heavens from what we observe on earth. Here we see the most violent blast of air has no effect upon a stream of electric fluid; in the celestial regions, either air or some other fluid has an effect upon it according to Dr Hamilton. The resistance of that fluid, therefore, must be greater than that of the most violent blast of air we can imagine.

As to the Doctor's method of accounting for the curvature of the comet's tail, it might do very well on Sir Isaac Newton's principles, but cannot do so on his. There is no comparison between the celerity with which rarefied vapour ascends in our atmosphere, and that whereby the electric fluid is discharged. The velocity of the latter seems to equal that of light; of consequence, supposing the velocity of the comet to be equal to that of the earth in its annual course, and its tail equal in length to the distance of the sun from the earth, the curvature of the tail could only be to a straight line as the velocity of the comet in its orbit is to the velocity of light, which, according to the calculations of Dr Bradley, is as 10,201 to 1. The apparent curvature of such a comet's tail, therefore, would at this rate

184 Prodigious velocity of a comet observed by Mr Brydone.

only be $\frac{1}{10201}$ part of its visible length, and thus would always be imperceptible to us. The velocity of comets is indeed sometimes inconceivably great. Mr Brydone observed one at Palermo, in July 1770, which in 24 hours described an arch in the heavens upwards of 50 degrees in length; according to which he supposes, that if it was as far distant as the sun, it must have moved at the rate of upwards of 60 millions of miles in a day. But this comet was attended with no tail, so that we cannot be certain whether the curvature of the tails of these bodies corresponds with their velocity or not.

The near approach of some comets to the sun subjects them to intense and inconceivable degrees of heat. Newton calculated that the heat of the comet of 1680 must have been near 2000 times as great as that of red hot iron. The calculation is founded upon this principle, that the heat of the sun falling upon any body at different distances is reciprocally as the squares of those distances; but it may be observed, that the effect of the heat of the sun upon all bodies near our earth depends very much on the constitution of those bodies, and of the air that surrounds them. "The comet in question (says Dr Long) certainly acquired a prodigious heat; but I cannot think it came up to what the calculation makes it: the effect of the strongest burning-glass that has ever been made use of was the vitrification of most bodies placed in its focus. What would be the effect of a still greater heat we can only conjecture; it would perhaps so disunite the parts as to make them fly off every way in atoms. This comet, according to Halley, in passing thro' its southern node, came within the length of the sun's semidiameter of the orbit of the earth. Had the earth then been in the part of her orbit nearest to that node, their mutual gravitation must have caused a change in the plane of the orbit of the earth, and in the length of our year: he adds, that if so large a body with so rapid a motion as that of this comet were to strike against the earth, a thing by no means impossible, the shock might reduce this beautiful frame to its original chaos."

185 Vehement heat of the comet of 1680.

We must not conclude this account without observing, that Whiston, who, from Flamstead's measure of its apparent diameter, concluded the nucleus of the comet to be about ten times as big as the moon, or equal to a fourth part of the earth, attributes the universal deluge in the time of Noah to the near approach thereof. His opinion was, that the earth passing thro' the atmosphere of the comet, attracted therefrom great part of the water of the flood; that the nearness of the comet raised a great tide in the subterraneous waters, so that the outer crust of the earth was changed from a spherical to an oval figure; that this could not be done without making fissures and cracks in it, thro' which the waters forced themselves by the hollow of the earth being changed into a less capacious form; that along with the water thus squeezed up on the surface of the earth, much slime or mud would rise; which, together with the grosser part of the comet's atmosphere, would after the subsiding of the water, partly into the fissures and partly into the lower parts of the earth to form the sea, cover all over, to a considerable depth, the antediluvian earth. Thus he accounts for trees and bones of animals being found at very great depths in the earth. He also held that, before the fall, the earth revolved round the sun in the plane of the ecliptic, keeping always the same points of its surface towards the same fixed stars. By this means, as every meridian would come to the sun but once in every revolution, a day and a year were then the same: but that

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that a comet striking obliquely upon some part of the earth gave it the diurnal rotation; that the antediluvian year consisted of 360 days; but that the additional matter deposited upon the earth from the atmosphere of the comet at the flood so retarded the revolution thereof round the sun, that it is not now performed in less than 365 days and about a quarter. The same comet he thought would probably, coming near the earth when heated in an immense degree in its perihelion, be the instrumental cause of that great catastrophe, the general conflagration, foretold in the sacred writings and from ancient tradition.

186 Conjectures of Hevelius, &c. concerning the nature of comets.

These conjectures lead us to speak somewhat more particularly concerning the nature of the comets, and the purposes they may possibly answer in the creation. Hevelius, in order to account for the various appearances of the nucleus already related, supposed that they were composed of several masses compacted together with a transparent fluid interspersed, but the apparent changes in the nucleus may be only on the surface: comets may be subject to spots as the planets are; and the vastly different degrees of heat they go through may occasion great and sudden changes, not only in their surfaces, but even in their internal frame and texture. Newton places all these apparent changes to the atmosphere that environs them; which must be very dense near the surface, and have clouds floating therein. It was his opinion, that the changes mentioned may all be in the clouds, not in the nucleus. This last indeed he looked upon to be a body of extreme solidity, in order to sustain such an intense heat as the comets are sometimes destined to undergo; and that, notwithstanding their running out into the immense regions of space, where they were exposed to the most intense degrees of cold, they would hardly be cooled again on their return to the sun. Indeed, according to his calculation, the comet of 1680 must be for ever in a state of violent ignition. He hath computed that a globe of red-hot iron of the same dimensions with the earth, would scarce be cool in 50,000 years. If then the comet be supposed to cool 100 times faster than red-hot-iron, as its heat was 2000 times greater, it must require upwards of a million of years to cool it. In the short period of 575 years, therefore, its heat will be in a manner scarce diminished; and, of consequence, in its next and every succeeding revolution, it must acquire an increase of heat: so that, since the creation, having received a proportional addition in every succeeding revolution, it must now be in a state of ignition very little inferior to that of the sun itself. Sir Isaac Newton hath farther concluded, that this comet must be considerably retarded in every succeeding revolution by the atmosphere of the sun within which it enters; and thus must continually come nearer and nearer his body, till at last it falls into it. This, he thinks, may be one use of the comets, to furnish fuel for the sun, which otherwise would be in danger of wasting from the continual emission of its light.

He adds, that for the conservation of the water and moisture of the planets, comets seem absolutely requisite; from whose condensed vapours and exhalation all the moisture which is spent in vegetation and putrefaction, and turned into dry earth, &c. may be resupplied and recruited; for all vegetables grow and increase wholly from fluids; and again, as to their greatest part, turn by putrefaction into earth; an earthy slime being perpetually precipitated to the bottom of putrefying liquors. Hence the quantity of dry earth must continually increase, and the moisture of the globe decrease, and be quite evaporated, if it have not a continual supply from some part or other of the universe. "And I suspect (adds our great author), that the spirit, which makes the finest, subtilest, and best part of our air, and which is absolutely requisite for the life and being of all things, comes principally from the comets."

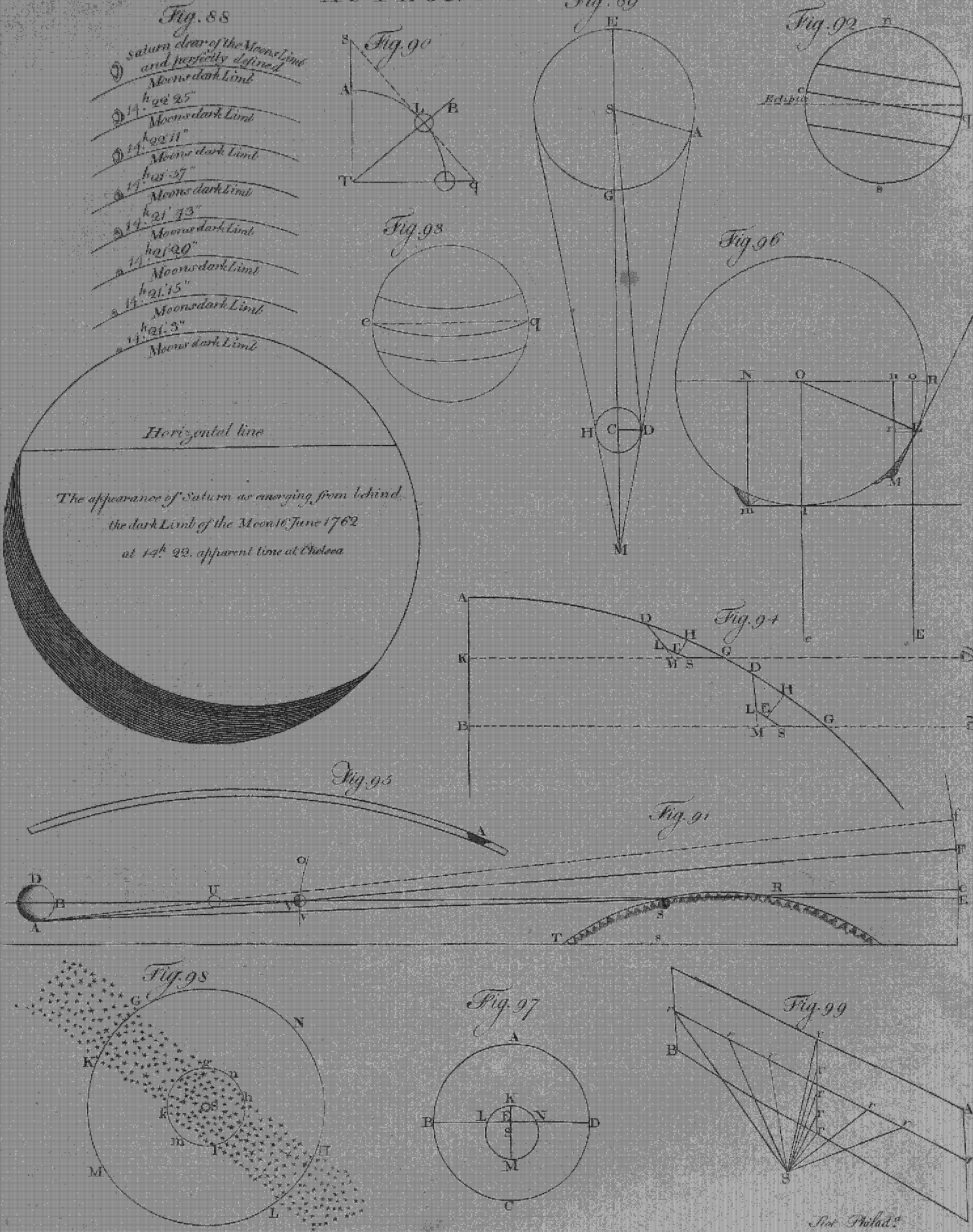
187 Mr Brydone's conjectures concerning comets without tails.

Mr Brydone observes, that the comets without tails seem to be of a very different species from those which have tails: To the latter, he says, they appear to bear a much less resemblance than they do even to planets. He tells us, that comets with tails have seldom been visible but on their recess from the sun: that they are kindled up, and receive their alarming appearance, in their near approach to this glorious luminary; but that those without tails are seldom or never seen but on their way to the sun; and he does not recollect any whose return has been tolerably well ascertained. "I remember indeed (says he), a few years ago, a small one, that was said to have been discovered by a telescope after it had passed the sun, but never more became visible to the naked eye. This assertion is easily made, and nobody can contradict it; but it does not at all appear probable that it should have been so much less luminous after it had passed the sun than before it approached him: and I will own to you, when I have heard that the return of these comets had escaped the eyes of the most acute astronomers, I have been tempted to think that they did not return at all, but were absorbed in the body of the sun, which their violent motion towards him seemed to indicate." He then attempts to account for the continual emission of the sun's light without waste, by supposing that there are numberless bodies throughout the universe that are attracted into the body of the sun, which serve to supply the waste of light, and which for some time remain obscure and occasion spots on his surface, till at last they are perfectly dissolved and become bright like the rest. This hypothesis may account for the dark spots becoming as bright, or even brighter, than the rest of the disk, but will by no means account for the brighter spots becoming dark. Of this comet too, Mr Brydone remarks, that it was evidently surrounded by an atmosphere which refracted the light of the fixed stars, and seemed to cause them change their places as the comet came near them.

188 Mr Cole's hypothesis.

A very strange opinion we find set forth in a book entitled "Observations and Conjectures on the Nature and Properties of Light, and on the Theory of Comets, by William Cole." This gentleman supposes that the comets belong to no particular system; but were originally projected in such directions as would successively expose them to the attraction of different centres, and thus they would describe various curves of the parabolic and the hyperbolic kind. This treatise is written in answer to some objections thrown out in Mr Brydone's Tour, against the motions of the comets by means of the two forces of gravitation and projection, which

ASTRONOMY Plate LXIX



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which were thought sufficient for that purpose by Sir Isaac Newton; of which we shall treat as fully as our limits will allow in the next section.

189
Of the periodical times, &c. of the comets.

The analogy between the periodical times of the planets and their distances from the sun discovered by Kepler, takes place also in the comets. In consequence of this, the mean distance of a comet from the sun may be found by comparing its period with the time of the earth's revolution round the sun. Thus the period of the comet that appeared in 1531, 1607, 1682, and 1759, being about 76 years, its mean distance from the sun may be found by this proportion: As 1, the square of one year, the earth's periodical time, is to 5776 the square of 76, the comet's periodical time; so is 1,000,000, the cube of 100 the earth's mean distance from the sun, to 5,776,000,000, the cube of the comet's mean distance. The cube root of this last number is 1794, the mean distance itself in such parts as the mean distance of the earth from the sun contains 100. If the perihelion distance of this comet, 58, be taken from 3588 double the mean distance, we shall have the aphelion distance, 3530, of such parts as the distance of the earth contains 100; which is a little more than 35 times the distance of the earth from the sun. By a like method, the aphelion distance of the comet of 1680 comes out 138 times the mean distance of the earth from the sun, supposing its period to be 575 years; so that this comet in its aphelion, goes more than 14 times the distance from the sun that Saturn does. Euler computes the orbit of this comet from three of Flamstead's observations taken near together, compared with a fourth taken at some distance from the other three; and from thence concludes the period to be a little more than 170 years. "It seems something surprising (says Dr Long), that, from the same observations which were used by Newton and Halley, he should bring out a period so very different from what those great men have determined: but it is the less to be wondered at, if we consider how small a portion of the comet's orbit lay between the most distant places used in this computation, or indeed that could be had for that purpose; so small, that the form of the ellipsis cannot be found with precision by this method, except the comet's places were more exactly verified than is possible to be done: and that he does not pretend to confirm his determination of the period by pointing out and comparing together any former appearances of this comet; a method which Newton recommended as the only one whereby the periodical times and transverse diameters of the orbits of the comets can be determined with accuracy."

The period of the comet in 1744 is much longer than even that of 1680. Mr Betts, in attempting to compute the transverse axis of its orbit, found it come out so near infinite, that, though the orbit showed itself in this manner to be a very long one, he found it impossible to calculate it without some observations made after its perihelion. Halley, after he had finished his table of comets, found such a similitude in the elements of those of 1531, 1607, and 1682, that he was induced to believe them to be returns of the same comet in an elliptic orbit: but as there was such a difference in their periodical times and inclinations of their orbits as seemed to make against this opinion; and as the observations of the first of them in 1531 by Apian, and the second in 1607 by Kepler were not exact enough to determine so nice a point when he first published his synopsis in 1705; he only mentioned this as a thing probable, and recommended it to posterity to watch for an appearance of the same in 1758. Afterwards, looking over the catalogue of ancient comets, and finding three others at equal intervals with those now mentioned, he grew more positive in his opinion; and knowing a method of calculating with ease a motion in an elliptic orbit, how eccentric soever it might be, instead of the parabolic orbit which he had given for the comet of 1682, he set about adapting the plan of that orbit to an ellipsis of a given space and magnitude, having the sun in one of its foci, so as to tally with the observations of that comet made by Flamstead with great accuracy, by the help of a very large sextant. He likewise corrected the places of the comet of 1531 from Apian, and those of the comet 1607 from Kepler and Longomontanus, by rectifying the places of the stars they had made use of, and found those places agree as well with the motion in such an ellipsis as could be expected from the manner of observing of these astronomers and the imperfections of their instruments. The greatest objection to this theory was some difference in the inclination of the orbits, and that there was above a year's difference between the two periods. The comet of 1531 was in its perihelion August 24.; that of 1607, October 16.; and that of 1682, September 4.: so that the first of these periods was more than 76, the latter not quite 75 years. To obviate this, he reminds his readers of an observation made by him of the periodical revolution of Saturn having at one time been about 13 days longer than at another time; occasioned, as he supposed, by the near approach of Saturn and Jupiter, and the mutual attraction and gravitation of the two planets: and observes, that in the summer of the year 1681, the comet in its descent was for some time so near Jupiter, that its gravitation towards that planet was one-fiftieth part of its gravitation towards the sun. This, he concluded, would cause a change in the inclination of its orbit, and also in the velocity of its motion: for by continuing longer near the planet Jupiter on the side most remote from the sun, its velocity, would be more increased by the joint forces of both those bodies, than it would be diminished by them acting contrary-wise, when on the side next to the sun where its motion was swiftest. The projectile motion being thus increased, its orbit would be enlarged, and its period lenghtened; so that he thought it probable it would not return till after a longer period than 76 years, about the end of the year 1758 or beginning of 1759.

190
Dr Halley calculates the return of comets.

191
Why the periodical return of comets may happen at unequal intervals.

As Halley expressed his opinon modestly, though clearly enough, that this comet would appear again about the end of 1758, or the beginning of the following year, M. de la Lande pretends he must have been at a loss to know whether the period he foretold would have been of 75 or of 76 years; that he did not give a decisive prediction, as if it had been the result of calculation; and that, by considering the affair in so loose a manner as Halley did, there was a good deal of room for objecting to his reasoning. After these reflections, he is very large in his commendation of the performance of Mr Clairault; who, he says, not

only

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only calculated strictly the effect of the attraction of Jupiter in 1681 and 1683, when the comet was again near Jupiter, but did not neglect the attraction of that planet when the comet was most distant; that he considered the uninterrupted attractions of Jupiter and Saturn upon the sun and upon the comet, but chiefly the attraction of Jupiter upon the sun, whereby that luminary was a little displaced, and gave different elements to the orbit of the comet. By this method he found the comet would be in its perihelion about the middle of April: but that, on account of some small quantities necessarily neglected in the method of approximation made use of by him, Mr. Clairault desired to be indulged one month; and that the comet came just 30 days before the time he had fixed for its appearance.

That comets may have their motion disturbed by the planets, especially by the two largest, Jupiter and Saturn, appears by an instance just now mentioned. They may also affect one another by their mutual gravitation when out of the planetary regions; but of this we can take no account, nor can we estimate the resistance of the ether through which they pass; and yet both these causes may have some influence on the inclination of their orbits and the length of their periods.

192 Fixed stars supposed to be suns.

THUS much concerning the bodies of which our solar system is composed. But the conjectures of astronomers have reached even beyond its boundaries: they have supposed every one of the innumerable multitude of fixed stars to be a sun attended by planets and comets, each of which is an habitable world like our own; so that the universe may in some measure be represented by fig. 161. where several adjacent systems are marked. The strongest argument for this hypothesis is, that they cannot be magnified by a telescope on account of their extreme distance; whence we must conclude that they shine by their own light, and are therefore as many suns; each of which we may suppose to be equal, if not superior, in lustre and magnitude to our own. They are not supposed to be at equal distances from us, but to be more remote in proportion to their apparent smallness. This supposition is necessary to prevent any interference of their planets; and thus there may be as great a distance between a star of the first magnitude and one of the second apparently close to it, as between the earth and the fixed stars first mentioned.

193 Opposed, from the variable nature of the stars.

Those who take the contrary side of the question affirm, that the disappearance of some of the fixed stars is a demonstration that they cannot be suns, as it would be to the highest degree absurd to think that God would create a sun which might disappear of a sudden, and leave its planets and their inhabitants in endless night. Yet this opinion we find adopted by Dr Keill, who tells us, "It is no ways improbable that these stars lost their brightness by a prodigious number of spots which entirely covered and overwhelmed them. In what dismal condition must their planets remain, who have nothing but the dim and twinkling light of the fixed stars to enlighten them?" Others, however, have made suppositions more agreeable to our notions of the benevolent character of the Deity. Sir Isaac Newton thinks that the sudden blaze of some stars may have been occasioned by the falling of a comet into them, by which means they would be enabled to emit a prodigious light for a little time, after which they would gradually return to their former state. Others have thought that the variable ones, which disappear for a time, were planets, which were only visible during some part of their course. But this their apparent immobility, notwithstanding their decrease of lustre, will not allow us to think. Some have imagined, that one side of them might be naturally much darker than the other, and when by the revolution of the star upon its axis the dark side was turned towards us, the star became invisible, and, for the same reason, after some interval, resumed its former lustre.

194 Conjectures concerning new stars, &c.

195 Opinion of M. Maupertuis.

M. Maupertuis, in his dissertation on the figures of the celestial bodies (p. 61—63.), is of opinion, that some stars, by their prodigious quick rotations on their axes, may not only assume the figures of oblate spheroids, but that, by the great centrifugal force arising from such rotations, they may become of the figures of mill-stones; or be reduced to flat circular planes, so thin as to be quite invisible when their edges are turned towards us; as Saturn's ring is in such positions. But when very eccentric planets or comets go round any flat star, in orbits much inclined to its equator, the attraction of the planets or comets in their perihelions must alter the inclination of the axis of that star; on which account it will appear more or less large and luminous, as its broad side is more or less turned towards us. And thus he imagines we may account for the apparent changes of magnitude and lustre in those stars, and likewise for their appearing and disappearing.

196 Mr Dunn's hypothesis.

Lastly, Mr Dunn (Phil. Transf. Vol. LII.) in a dissertation concerning the apparent increase of magnitude in the heavenly bodies when they approach the horizon, conjectures that the interposition of some gross atmosphere may solve the phenomena both of nebulous and new stars. "The phenomena of nebulous and new stars (says he) have engaged the attention of curious astronomers; but none that I know of have given any reason for the appearance of nebulous stars. Possibly what has been before advanced may also be applicable for investigating reasons for those strange appearances in the remote parts of the universe. From many instances which might be produced concerning the nature and properties of lights and illuminations on the earth's surface, concerning the nature and properties of the earth's atmosphere, and concerning the atmospheres and illuminations of comets, we may safely conclude, that the atmospheres of comets and of our earth are more gross in their nature than the etherial medium which is generally diffused through the solar system. Possibly a more aqueous vapour in the one than the other makes the difference. Now, as the atmospheres of comets and of planets in our solar system are more gross than the ether which is generally diffused through our solar system, why may not the etherial medium diffused throughout those other solar systems (whose centres are their respective fixed stars) be more gross than the etherial medium diffused throughout our solar system? This indeed is an hypothesis, but such an one as agrees exactly with nature. For these nebulous stars appear so much like comets, both to the naked eye and through telescopes, that the one cannot always, by any difference of their extraneous light, be known from the other. Such orbs of gross ether reflecting

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flecting light more copiously, or like the atmospheres of comets, may help us to judge of the magnitudes of the orbs illuminated by those remote suns, when all other means seem to fail. The appearance of new stars, and disappearance of others, possibly may be occasioned by the interposition of such an etherial medium, within their respective orbs, as either admits light to pass freely, or wholly absorbs it at certain times, whilst light is constantly pursuing its journey through the vast regions of space."

In the Philosophical Transactions for 1783, however, Mr Michell, in proposing a method to determine the distance, magnitude, &c. of the fixed stars by the diminution of the velocity of their light, should any such thing be discovered, makes such suppositions as seem totally inconsistent with what has been just now advanced. "The very great number of stars (says he) that have been discovered to be double, treble, &c. particularly by Mr Herschel, if we apply the doctrine of chances, as I have heretofore done in my Inquiry into the probable parallax, &c. of the fixed stars, published in the Philosophical Transactions for the year 1767, cannot leave a doubt with any one who is properly acquainted with the force of those arguments, that by far the greatest part, if not all of them, are systems of stars so near each other, as probably to be liable to be affected sensibly by their mutual gravitation; and it is therefore not unlikely, that the periods of the revolutions of some of these about their principals (the smaller ones being, upon this hypothesis, to be considered as satellites to the others) may some time or other be discovered." Having then shown in what manner the magnitude of a fixed star, if its density were known, would affect the velocity of its light, he concludes at last, that "if the semidiameter of a sphere of the same density with the sun were to exceed his in the proportion of 500 to 1, a body falling from an infinite height towards it (or moving in a parabolic curve at its surface) would have acquired a greater velocity than that of light; and consequently, supposing light to be attracted by the same force in proportion to its *vis inertiæ* with other bodies, all light emitted from such a body would be made to return towards it by its own proper gravity. But if the semidiameter of a sphere, of the same density with the sun, was of any other size less than 497 times that of the sun, though the velocity of light emitted by such a body would never be wholly destroyed, yet it would always suffer some diminution, more or less according to the magnitude of the sphere. The same effects would likewise take place if the semidiameters were different from those already mentioned, provided the density was greater or less in the duplicate ratio of those semidiameters inversely."

197 Mr Michell's conjectures concerning the nature of the fixed stars.

198 In what cases light may be supposed to return to the body that emits it.

After proceeding in his calculations, in order to find the diameter and distance of any star, he proceeds thus: "According to Mr Bouguer, the brightness of the sun exceeds that of a wax candle in no less a proportion than that of 8000 to 1. If therefore the brightness of any of the fixed stars should not exceed that of our common candles, which, as being something less luminous than wax, we will suppose in round numbers to be only one ten thousandth part as bright as the sun, such a star would not be visible at more than one hundredth part of the distance at which it would be seen if it were as bright as the sun. Now, because the sun would still, I apprehend, appear as bright and luminous as the star Sirius, if removed to 400,000 times his present distance, such a body, if no brighter than our common candles, would only appear equally luminous with that star at 4000 times the distance of the sun; and we might then be able, with the best telescopes, to distinguish some sensible apparent diameter of it: but the apparent diameters of the stars of lesser magnitudes would still be too small to be distinguishable even with our best telescopes, unless they were yet a good deal less luminous; which may possibly, however, be the case with some of them: for though we have indeed very slight grounds to go upon with regard to the specific brightness of the fixed stars, compared with that of the sun at present, and can therefore form only very uncertain and random conjectures concerning it; yet from the infinite variety which we find in the works of the creation, it is not unreasonable to suspect, that very possibly some of the fixed stars may have so little natural brightness in proportion to their magnitude, as to admit of their diameters having some sensible apparent size when they shall come to be more carefully examined, and with larger and better telescopes than have been hitherto in common use.

199 Comparative brightness of the sun and fixed stars.

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"With regard to the sun, we know that his whole surface is extremely luminous, a very small and temporary interruption sometimes, from a few spots, excepted. This universal and excessive brightness of the whole surface is probably owing to an atmosphere, which being luminous throughout, and in some measure also transparent, the light proceeding from a considerable depth of it all arrives at the eye, in the same manner as the light of a great number of candles would do if they were placed one behind another, and their flames were sufficiently transparent to permit the light of the more distant ones to pass through those that were nearer without interruption.

200 Luminous appearance of the sun supposed to proceed from an atmosphere

"How far the same constitution may take place in the fixed stars we do not know: probably, however, it may still do so in many; but there are some appearances, with regard to a few of them, which seem to make it probable that it does not do so universally. Now, if I am right in supposing the light of the sun to proceed from a luminous atmosphere which must necessarily diffuse itself equally over the whole surface, and I think there can be very little doubt that this is really the case, this constitution cannot well take place in those stars which are in some degree periodically more and less luminous, such as that in Collo Ceti, &c. It is also not very improbable, that there is some difference from that of the sun in the constitution of those stars which have sometimes appeared and disappeared, of which that in the constellation of Cassiopeia is a notable instance. And if these conjectures are well founded, which have been formed by some philosophers, concerning stars of this kind, that they are not wholly luminous, or at least not constantly so, but that all, or by far the greatest part of their surfaces, is subject to considerable changes, sometimes becoming luminous, at others extinguished; it is amongst stars of this sort that we are most likely to meet with instances of a sensible apparent diameter, their light being much more likely not to be so great in proportion as that of the sun, which if removed to 400,000 times his present distance, would still appear,

201 Of the variable stars.

I ap-

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I apprehend, as bright as Sirius, as I have observed above; whereas it is hardly to be expected, with any telescope whatsoever, that we should ever be able to distinguish a well-defined disk of any body of the same size with the sun at much more than 10,000 times his present distance.

"Hence the greatest distance at which it would be possible to distinguish any sensible apparent diameter of a body as dense as the sun, cannot well greatly exceed five hundred times ten thousand; that is five million times the distance of the sun; for if the diameter of such a body was not less than 500 times that of the sun, its light, as has been shown above, could never arrive at us."

202 Mr Herschel's opinion concerning the construction of the universe.

Mr Herschel improving on Mr Michell's idea of the fixed stars being collected into groups, and assisted by his own observations with the extraordinary telescopic powers already mentioned, has suggested a theory concerning the construction of the universe entirely new and singular. It had been the opinion of former astronomers, that our sun, besides occupying the centre of the system which properly belongs to him, occupied also the centre of the universe; but Mr Herschel is of a very different opinion. "Hitherto (says he) the sidereal heavens have, not inadequately for the purpose designed, been represented by the concave surface of a sphere, in the centre of which the eye of the observer might be supposed to be placed." It is true, the various magnitudes of the fixed stars even then plainly suggested to us, and would have better suited the idea of an expanded firmament of three dimensions; but the observations upon which I am now going to enter, still farther illustrate and enforce the necessity of considering the heavens in this point of view. In future therefore we shall look upon those regions into which we may now penetrate by means of such large telescopes *, as a naturalist regards a rich extent of ground or chain of mountains, containing strata variously inclined and directed, as well as consisting of very different materials. A surface of a globe or map therefore will but ill delineate the interior parts of the heavens."

203 His observations on the Via Lactea.

With the powerful telescope mentioned in the note, Mr Herschel first began to survey the Via Lactea, and found that it completely resolved the whitish appearance into stars, which the telescopes he formerly used had not light enough to do. The portion he first observed was that about the hand and club of Orion; and found therein an astonishing multitude of stars, whose number he endeavoured to estimate by counting many fields †, and computing from a mean of these how many might be contained in a given portion of the milky way. In the most vacant place to be met with in that neighbourhood he found 63 stars; other six fields contained 110, 60, 70, 90, 70, and 74 stars; a mean of all which gave 79 for the number of stars to each field: and thus he found, that by allowing 15 minutes for the diameter of his field of view, a belt of 15 degrees long and two broad, which he had often seen pass before his telescope in an hour's time, could not contain less than 50,000 stars, large enough to be distinctly numbered; besides which, he suspected twice as many more, which could be seen only now and then by faint glimpses for want of sufficient light.

204 On the nebulæ.

The success he had in the milky-way soon induced him to turn his telescope to the nebulous parts of the heavens, of which an accurate list had been published in the *Connoissance des Temps* for 1783 and 1784. Most of these yielded to a Newtonian reflector of 20 feet focal distance and 12 inches aperture; which plainly discovered them to be composed of stars, or at least to contain stars, and to show every other indication of consisting of them entirely.

205 They are arranged into strata.

"The nebulæ (says he) are arranged into strata, and run on to a great length; and some of them I have been able to pursue, and to guess pretty well at their form and direction. It is probable enough that they may surround the whole starry sphere of the heavens, not unlike the milky-way, which undoubtedly is nothing but a stratum of fixed stars: and as this latter immense starry bed is not of equal breadth or lustre in every part, nor runs on in one straight direction, but is curved, and even divided into two streams along a very considerable portion of it; we may likewise expect the greatest variety in the strata of the clusters of stars and nebulæ. One of these nebulous beds is so rich, that in passing through a section of it in the time of only 36 minutes, I have detected no less than 31 nebulæ, all distinctly visible upon a fine blue sky.

206 Variety of shapes assumed by them.

Their situation and shape, as well as condition, seem to denote the greatest variety imaginable. In another stratum, or perhaps a different branch of the former, I have often seen double and treble nebulæ variously arranged; large ones with small, seemingly attendants; narrow, but much extended lucid nebulæ or bright dashes; some of the shape of a fan, resembling an electric brush issuing from a lucid point; others of the cometic shape, with a seeming nucleus in the centre, or like cloudy stars surrounded with a nebulous atmosphere: a different sort again contain a nebulosity of the milky kind, like that wonderful inexplicable phenomenon about θ Orionis; while others shine with a fainter mottled kind of light, which denotes their being resolvable into stars.

207 Why the milky-way appears to surround the heavens

"It is very probable that the great stratum called the *milky-way*, is that in which the sun is placed, though perhaps not in the very centre of its thickness. We gather this from the appearance of the galaxy, which seems to encompass the whole heavens, as it certainly must do if the sun is within the same. For suppose a number of stars arranged between two parallel planes, indefinitely extended every way, but at a given considerable distance from one another, and calling this a sidereal stratum, an eye placed somewhere within it will see all the stars in the direction of the planes of the stratum projected into a great circle, which will appear lucid on account of the accumulation of the stars, while the rest of the heavens at the sides will only seem to be scattered over with constellations, more or less

* Mr Herschel's observations, on which this theory is founded, were made with a Newtonian reflector of 20 feet focal length, and an aperture of 18 inches.

† By this word we are to understand the apparent space in the heavens he could see at once through his telescope.

Fig. 100.

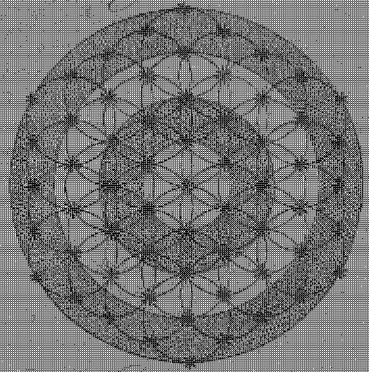


Fig. 102.

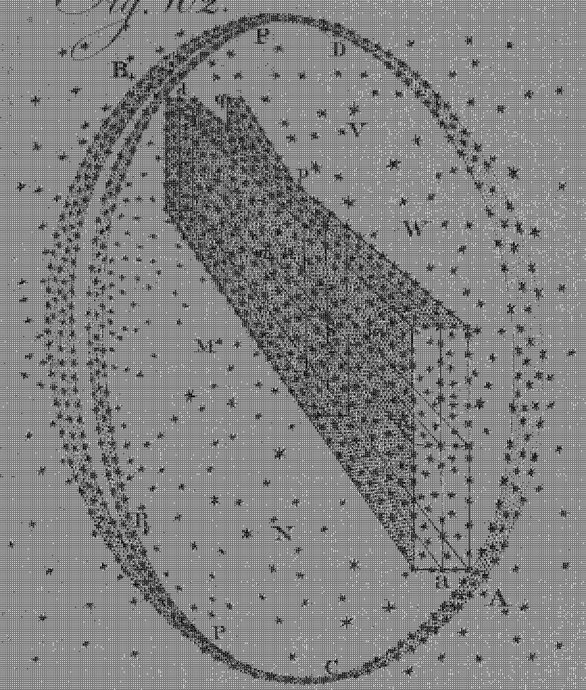


Fig. 101.

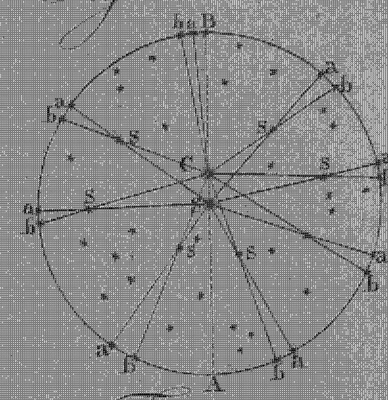


Fig. 103.

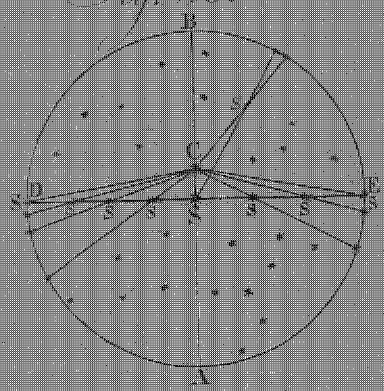


Fig. 104.

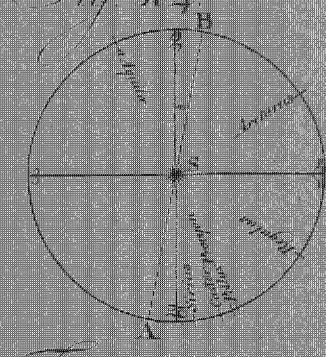


Fig. 106.

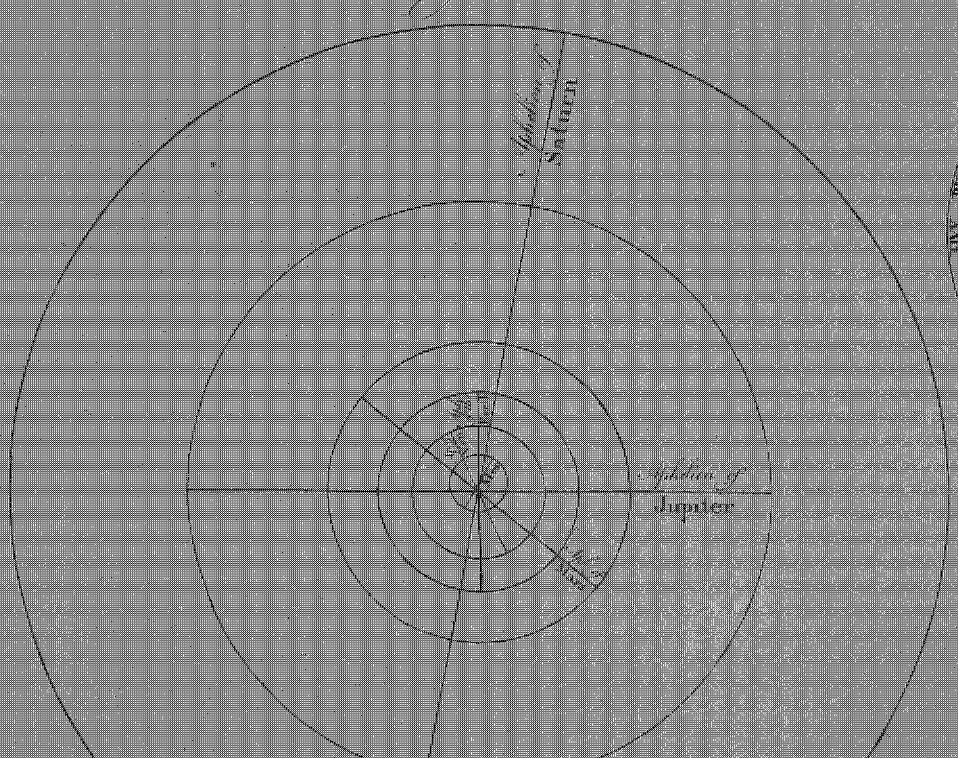


Fig. 105.

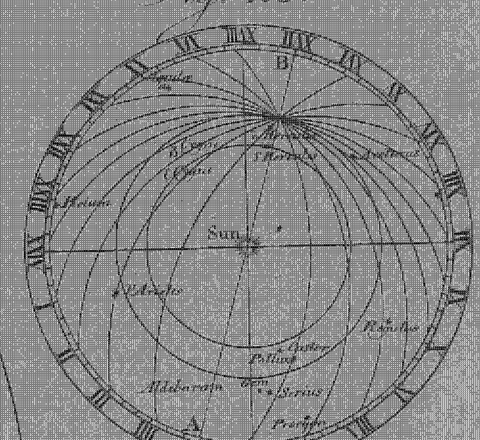
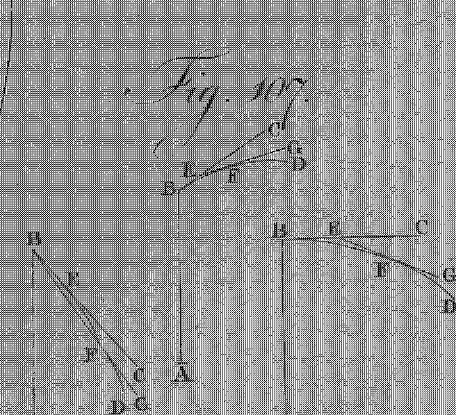


Fig. 107.



Thackara & Vallance sculpt.

Conclusions from the foregoing Appearances.

less crowded according to the distance of the planes or number of stars contained in the thickness or sides of the stratum.

"Thus in fig. 102. an eye at S within the stratum *ab*, will see the stars in the direction of its length *ab*, or height *ed*, with all those in the intermediate situation, projected into the lucid circle ABCD; while those in the sides *me*, *nw*, will be seen scattered over the remaining part of the heavens at MVNW.

208 Celestial appearances solved on Mr Herschel's hypothesis.

"If the eye were placed somewhere without the stratum, at no very great distance, the appearance of the stars within it would assume the form of one of the lesser circles of the sphere, which would be more or less contracted to the distance of the eye: and if this distance were exceedingly increased, the whole stratum might at last be drawn together into a lucid spot of any shape, according to the position, length, and height of the stratum.

"Let us now suppose, that a branch or smaller stratum should run out from the former in a certain direction, and let it also be contained between two parallel planes extended indefinitely onwards, but so that the eye may be placed in the great stratum somewhere before the separation, and not far from the place where the strata are still united; then will this second stratum not be projected into a bright circle like the former, but will be seen as a lucid branch proceeding from the first, and returning to it again at a certain distance less than a semicircle. Thus, in the same figure, the stars in the small stratum *p g* will be projected into a bright arch at PRRP, which, after its separation from the circle CBD, unites with it again at P.

"What has been instanced in parallel planes may easily be applied to strata irregularly bounded, and running in various directions; for their projection will of consequence vary according to the quantities of the variations in the strata and the distance of the eye from the same. And thus any kind of curvatures, as well as various degrees of brightness, may be produced in the projections.

209 Of the sun's place in the universe.

"From appearances, then, as I observed before, we may infer, that the sun is most likely placed in one of the great strata of the fixed stars, and very probably not far from the place where some smaller stratum branches out from it. Such a supposition will satisfactorily, and with great simplicity, account for all the phenomena of the milky way; which according to this hypothesis, is no other than the appearance of the projection of the stars contained in this stratum and its secondary branch. As a farther inducement to look on the galaxy in this point of view, let it be considered, that we can no longer doubt of its whitish appearance arising from the mixed lustre of the numberless stars that compose it. Now, should we suppose it to be an irregular ring of stars, in the centre nearly of which we must then suppose the sun to be placed, it will appear not a little extraordinary, that the sun, being a fixed star like those which compose this imagined ring, should just be in the centre of such a multitude of celestial bodies, without any apparent reason for this singular distinction; whereas, on our supposition, every star in this stratum, not very near the termination of its length or height, will be so placed as also to have its own galaxy, with only such variations in the form and lustre of it as may arise from the particular situation of each star.

"Various methods may be taken to come to a knowledge of the sun's place in the sidereal stratum, one of which I have already begun to put in practice. I call it *gauging the heavens*, or the *star-gauge*. It consists in repeatedly taking the number of stars in ten fields of view of my reflector very near each other; and by adding their sums, and cutting off one decimal on the right, a mean of the contents of the heavens in all the parts which are thus gauged are obtained. Thus it appears, that the number of stars increases very much as we approach the milky way; for in the parallel from 92 to 24 degrees north polar distance, and right ascension 15h. 10′, the star-gauge runs up from 9.4 stars in the field to 18.6 in about an hour and an half; whereas in the parallel from 78 to 80 degrees north polar distance, and R. A. 11, 12, 13, and 14 hours, it very seldom rises above 4. We are, however, to remember, that, with different instruments, the account of the gauges will be very different, especially on our supposition of the sun in a stratum of stars. For let *ab*, fig. 98. be the stratum, and suppose the small circle *g h l k* to represent the space into which, by the light and power of a given telescope, we are enabled to penetrate, and let GHLK be the extent of another portion which we are enabled to visit by means of a larger aperture and power; it is evident, that the gauges with the latter instrument will differ very much in their account of stars contained at MN and at KG or LH, when with the former they will hardly be affected with the change from *m n* to *kg* or *lk*.

210 Herschel's method of gauging the heavens.

211 How to find the place of the sun in the sidereal stratum.

"The situation of the sun in the sidereal stratum will be found by considering in what manner the star-gauge agrees with the length of a ray revolving in several directions about an assumed point, and cut off by the bounds of the stratum. Thus, in fig. 99. let S be the place of an observer; Srrr, *Srrr*, lines in the plane rSr, *rSr*, drawn from S within the stratum to one of the boundaries here represented by the plane AB. Then, since neither the situation of S nor the form of the limiting surface AB is known, we are to assume a point, and apply to it lines proportional to the several gauges that have been obtained, and at such angles from each other as they may point out; then will the termination of these lines delineate the boundary of the stratum, and consequently manifest the situation of the sun within the same.

112 Observations on nebulæ.

"In my late observations on nebulæ, I soon found, that I generally detected them in certain directions rather than in others: that the spaces preceding them were generally quite deprived of their stars, so as often to afford many fields without a single star in it: that the nebulæ generally appeared some time after among stars of a certain considerable size, and but seldom among very small stars: that when I came to one nebula, I generally found several more in the neighbourhood: that afterwards a considerable time passed before I came to another parcel. These events being often repeated in different altitudes of my instrument, and some of them at considerable distances from each other, it occurred to me that the intermediate spaces between the sweeps might also contain nebulæ; and finding this to hold good more than once, I ventured to give notice

Conclusions from the foregoing Appearances.

notice to my assistant at the clock, that 'I found myself on nebulous ground.' But how far these circumstances of vacant places preceding and following the nebulous strata, and their being as it were contained in a bed of stars sparingly scattered between them, may hold good in more distant portions of the heavens, and which I have not yet been able to visit in any regular manner, I ought by no means to hazard a conjecture.

213 Direction of some of the principal strata of stars.

I may venture, however, to add a few particulars about the direction of some of the capital strata, or their branches. The well-known nebula of Cancer, visible to the naked eye, is probably one belonging to a certain stratum, in which I suppose it to be so placed as to lie nearest to us. This stratum I shall call that of Cancer. It runs from ε Cancri towards the south, over the 67th nebula of the *Connoissance des Temps*, which is a very beautiful and pretty much compressed cluster of stars, easily to be seen by any good telescope; and in which I have observed above 200 stars at once in the field of view of my great reflector with a power of 157. This cluster appearing so plainly with any good common telescope, and being so near to the one which may be seen with the naked eye, denotes it to be probably the next in distance to that within the quartile formed by γ, δ, η, θ. From the 67th nebula, the stratum of Cancer proceeds towards the head of Hydra; but I have not yet had time to trace it farther than the equator.

"Another stratum, which perhaps approaches nearer to the solar system than any of the rest, and whose situation is nearly at rectangles with the great sidereal stratum in which the sun is placed, is that of Coma Berenices, as I shall call it. I suppose the Coma itself to be one of the clusters in it, and that on account of its nearness it appears to be so scattered. It has many capital nebulæ very near it; and in all probability this stratum runs out a very considerable way. It may perhaps even make the circuit of the heavens, though very likely not in one of the great circles of the sphere; for unless it should chance to intersect the great sidereal stratum of the milky way before mentioned in the very place in which the sun is stationed, such an appearance would hardly be produced. However, if the stratum of Coma Berenices should extend so far as I apprehend it may, the direction of it towards the north lies probably, with some windings, through the Great Bear onwards to Cassiopeia, thence through the Girdle of Andromeda and the Northern Fish, proceeding towards Cetus; while towards the south it passes through the Virgin, probably on to the tail of Hydra and Centaurus."

* Philos. Trans. vol. 75.

214 Of the interior construction of the heavens.

By a continued series of observations, Mr Herschel became confirmed in his notions; and in a succeeding paper has given a sketch of his opinions concerning the interior construction of the heavens.—"That the milky way (says he) is a most extensive stratum of stars of various sizes, admits no longer of the least doubt; and that our sun is one of the heavenly bodies belonging to it, is as evident. I have now viewed and gauged this shining zone in almost every direction, and find it composed of shining stars, whose number, by the account of those gauges, constantly increases and decreases in proportion to its apparent brightness to the naked eye. But in order to develope the ideas of the universe that have been suggested by my late observations, it will be best to take the subject from a point of view at a considerable distance both of space and time.

215 Consequences of the laws of attraction acting among the stars.

"Let us then suppose numberless stars of various sizes scattered over an indefinite portion of space, in such a manner as to be almost equally distributed thro' the whole. The laws of attraction which no doubt extend to the remotest regions of the fixed stars, will operate in such a manner as most probably to produce the following remarkable effects.

216 Nebulæ how formed.

"I. It will frequently happen, that a star, being considerably larger than its neighbouring ones, will attract them more than they will be attracted by others that are immediately around them; by which means they will be in time, as it were, condensed about a centre; or, in other words, form themselves into a cluster of stars of almost a globular figure, more or less regularly so according to the size and original distance of the surrounding stars. The perturbations of these mutual attractions must undoubtedly be very intricate, as we may easily comprehend by considering what Sir Isaac Newton has said, *Princip.* lib. i. prob. 38, *et seq.*: but in order to apply this great author's reasoning of bodies moving in ellipsis to such as are here for a while supposed to have no other motion than what their mutual gravity has imparted to them, we must suppose the conjugate axes of these ellipses indefinitely diminished, whereby the ellipses will become straight lines.

"II. The next case, which will happen almost as frequently as the former, is where a few stars, though not superior in size to the rest, may chance to be rather nearer each other than the surrounding ones; for here also will be formed a prevailing attraction in the combined centre of gravity of them all, which will occasion the neighbouring stars to draw together; not, indeed, so as to form a regular globular figure, but, however, in such a manner as to be condensed towards the common centre of gravity of the whole irregular cluster. And this construction admits of the utmost variety of shapes, according to the number and situation of the stars which first gave rise to the condensation of the rest.

"III. From the composition and repeated conjunction of both the foregoing forms, a third may be derived, when many large stars, or combined small ones, are situated in long extended regular or crooked rows, hooks, or branches; for they will also draw the surrounding ones so as to produce figures of condensed stars coarsely similar to the former, which gave rise to these condensations.

"IV. We may likewise admit of still more extensive combinations; when at the same time that a cluster of stars is forming in one part of space, there may be another collecting in a different, but perhaps not far distant quarter, which may occasion a mutual approach towards their common centre of gravity.

217 Vacancies how they are occasioned in the heavens.

"V. In the last place, as a natural consequence of the former cases, there will be great cavities or vacancies formed by the retreat of the stars towards the various centres which attract them; so that, upon the whole, there is evidently a field of the greatest variety for the mutual and combined attractions of the heavenly bodies to exert themselves in.

"From this theoretical view of the heavens, which

has

Concluſions from the foregoing Appearances.

has been taken from a point not leſs diſtant in time than in ſpace, we will now retreat to our own retired ſtation, in one of the planets attending a ſtar in its great combination with numberleſs others: and in order to inveſtigate what will be the appearances from this contracted ſituation, let us begin with the naked

218
How the ſtars muſt appear to us according to this hypotheſis.

eye. The ſtars of the firſt magnitude, being in all probability the neareſt, will furniſh us with a ſtep to begin our ſcale. Setting off, therefore, with the diſtance of Sirius or Arcturus, for inſtance, as unity, we will at preſent ſuppoſe, that thoſe of the ſecond magnitude are at double, thoſe of the third at treble, the diſtance, &c. Taking it for granted, then, that a ſtar of the ſeventh magnitude (the ſmalleſt ſuppoſed viſible with the naked eye) is about ſeven times as far as one of the firſt, it follows, that an obſerver who is incloſed in a globular cluſter of ſtars, and not far from the centre, will never be able with the naked eye to ſee to the end of it; for ſince, according to the above eſtimations, he can only extend his view to about ſeven times the diſtance of Sirius, it cannot be expected that his eyes ſhould reach the borders of a cluſter which has perhaps not leſs than 50 ſtars in depth every where around him. The whole univerſe to him, therefore, will be compriſed in a ſet of conſtellations richly ornamented with ſcattered ſtars of all ſizes. Or if the united brightneſs of a neighbouring cluſter of ſtars ſhould, in a remarkable clear night, reach his ſight, it will put on the appearance of a ſmall, faint, whitiſh, nebulous cloud, not to be perceived without the greateſt attention. Let us ſuppoſe him placed in a much extended ſtratum, or branching cluſter of millions of ſtars, ſuch as may fall under the third form of nebulæ already conſidered. Here alſo the heavens will not only be richly ſcattered over with brilliant conſtellations, but a ſhining zone or milky way will be perceived to ſurround the whole ſphere of the heavens, owing to the combined light of thoſe ſtars which are too ſmall, that is, too remote to be ſeen. Our obſerver's ſight will be ſo confined, that he will imagine this ſingle collection of ſtars, though he does not even perceive the thouſandth part of them, to be the whole contents of the heavens. Allowing him now the uſe of a common teleſcope, he begins to ſuſpect that all the milkineſs of the bright path which ſurrounds the ſphere may be owing to ſtars. He perceives a few cluſters of them in various parts of the heavens, and finds alſo that there are a kind of nebulous patches: but ſtill his views are not extended to reach ſo far as to the end of the ſtratum in which he is ſituated; ſo that he looks upon theſe patches as belonging to that ſyſtem which to him ſeems to comprehend every celeſtial object. He now increaſes his power of viſion; and, applying himſelf to a cloſe obſervation, finds that the milky way is indeed no other than a collection of very ſmall ſtars. He perceives, that thoſe objects which had been called *nebulæ*, are evidently nothing but cluſters of ſtars. Their number increaſes upon him; and when he reſolves one nebula into ſtars, he diſcovers ten new ones which he cannot reſolve. He then forms the idea of immenſe ſtrata of fixed ſtars, of cluſters of ſtars and of nebulæ; till, going on with ſuch intereſting obſervations, he now perceives, that all theſe appearances muſt naturally ariſe from the confined ſituation in which we are placed. *Confined* it may juſtly be called, though in no leſs a ſpace than what appeared before to be the whole region of the fixed ſtars, but which now has aſſumed the ſhape of a crookedly branching nebula; not indeed one of the leaſt, but perhaps very far from being the moſt conſiderable, of thoſe numberleſs cluſters that enter into the conſtruction of the heavens."

Concluſions from the foregoing Appearances.

219
Arguments in favour of the foregoing theory from obſervations on nebulæ.

Our author now proceeds to ſhow that this theoretical view of the heavens is perfectly conſiſtent with facts, and ſeems to be confirmed by a ſeries of obſervations. Many hundreds of nebulæ of the firſt and ſecond forms are to be ſeen in the heavens; and their places, he ſays, will hereafter be pointed out; many of the third form deſcribed, and inſtances of the fourth related; a few of the cavities mentioned in the fifth particulariſed, though many more have been already obſerved: ſo that, "upon the whole (ſays he), I believe it will be found, that the forgoing theoretical view, with all its conſequential appearances, as ſeen by an eye incloſed in one of the nebulæ, is no other than a drawing from nature, wherein the features of the original have been cloſely copied: and I hope the reſemblance will not be called a bad one, when it ſhall be conſidered how very limited muſt be the pencil of an inhabitant of ſo ſmall and retired a portion of an indefinite ſyſtem in attempting the picture of ſo unbounded an extent."

220
Method of meaſuring the dimenſions of the heavens.

Mr Herſchel next preſent us with a long table of ſtar-gauges, or accounts of the number of ſtars at once in the field of his teleſcope, which go as high as 588; after which he propoſes the following

PROBLEM.

"The ſtars being ſuppoſed nearly equally ſcattered, and their number, in a field of view of a known angular diameter, being given, to determine the length of the viſual ray.

"Here, the arrangement of the ſtars not being fixed upon, we muſt endeavour to find which way they may be placed ſo as to fill a given ſpace moſt equally. Suppoſe a rectangular cone cut into fruſtula by many equidiſtant planes perpendicular to the axis; then, if one ſtar be placed at the vertex and another in the axis at the firſt interſection, ſix ſtars may be ſet around it ſo as to be equally diſtant from one another and from the central ſtar. Theſe poſitions being carried on in the ſame manner, we ſhall have every ſtar within the cone ſurrounded by eight others at an equal diſtance from that ſtar taken at a centre. Fig. 100 contains four ſections of ſuch a cone diſtinguiſhed by alternate ſhades; which will be ſufficient to explain what ſort of arrangements I would point out.

"The ſeries of the number of ſtars contained in the ſeveral ſections will be 1, 7, 19, 37, 61, 91, &c. which, continued to n terms, the ſum of it, by the differential method, will be $na+n.\frac{n-1}{2}d'+n.\frac{n-1}{2}.\frac{n-2}{3}d''$, &c. where a is the firſt term, d', d'', d''', &c. the firſt, ſecond, and third differences. Then, ſince $a=1$, $d'=6$, $d''=6$, $d'''=0$, the ſum of the ſeries will be n^3. Let S be the given number of ſtars; 1 the diameter of the baſe of the field of view; and B the diameter of the great rectangular cone; and by trigonometry we ſhall

have

Conclusions from the foregoing Appearances.

have $B = \frac{\text{Radius}}{\text{Tang. } \frac{1}{2} \text{ field}}$. Now, since the field of view of a telescope is a cone, we shall have its solidity to that of the great cone of the stars formed by the above construction, as the square of the diameter of the base of the field of view to the square of the diameter of the great cone, the height of both being the same; and the stars in each cone being in the ratio of the solidity, as being equally scattered, we have $n = \sqrt[3]{B^2 S}$; and the length of the visual ray $= n - 1$, which was to be determined." Another solution of this problem, on the supposition of another arrangement of stars, is given; but Mr Herschel prefers the former.

221 Proofs of our sidereal system being a nebula.

From the data now laid down, Mr Herschel next endeavours to prove that the earth is 'the planet of a star belonging to a compound nebula of the third form.' "I shall now (says he) proceed to show, that the stupendous sidereal system we inhabit, this extensive stratum, and its secondary branch, consisting of many millions of stars, is in all probability *a detached nebula*. In order to go upon grounds that seem to me to be capable of great certainty, they being no less than an actual survey of the boundaries of our sidereal system, which I have plainly perceived as far as I have yet gone round it, every where terminated, and in most places very narrowly too, it will be proper to show the length of my sounding line, if I may so call it, that it may appear whether it was sufficiently long for the purpose.

222 Length of the line by which Mr Herschel measures the heavens.

"In the most crowded parts of the milky-way, I have had fields of view that contained no fewer than 588 stars, and these were continued for many minutes; so that in one quarter of an hour's time there passed no less than 116,000 stars through the field of view of my telescope. Now, if we compute the length of the visual ray, by putting $S = 588$, and the diameter of the field of view 15 minutes, we shall find $n = \sqrt[3]{B^2 S} = 498$; so that it appears the length of what I have called my Sounding Line, or $n - 1$, was not probably less than 497 times the distance of Sirius from the sun.

"It may seem inaccurate that we should found an argument on the stars being equally scattered, when, in all probability, there may not be any two of them in the heavens whose mutual distance shall be equal to that of any other two given stars: but it should be considered, that when we take all the stars collectively, there will be a mean distance which may be assumed as the general one; and an argument founded on such a supposition will have in its favour the greatest probability of not being far short of truth. And here I must observe, that the difference between a crowded place and a cluster (none of the latter being put into the gauge table), may easily be perceived by the arrangement as well as the size and mutual distance of the stars: for in a cluster they are generally not only resembling each other pretty nearly in size, but a certain uniformity of distance also takes place: they are more and more accumulated towards the centre, and put on all the appearances which we should naturally expect from a number of them collected into a group at a certain distance from us. On the other hand, the rich parts of the milky-way, as well as those in the distant broad parts of the stratum, consist of a mixture of stars of all possible sizes, that are seemingly placed without any particular apparent order. Perhaps we might recollect, that a greater condensation towards the centre of our system than towards the borders of it should be taken into consideration; but with a nebula of the third form, containing such various and extensive combinations as I have found to take place in ours, this circumstance, which in one of the first form would be of considerable moment, may, I think, be safely neglected.

223 Cluster of stars defined.

"If some other high gauge be selected from the table, such as 472 or 344, the length of the visual ray will be found 461 and 415. And although in consequence of what has been said, a certain degree of doubt may be left about the arrangement and scattering of the stars, yet when it is recollected, that in those parts of the milky-way, where these high gauges were taken, the stars were neither so small nor so crowded as they must have been, on a supposition of a much farther continuance of them, when certainly a milky or nebulous appearance must have come on, I need not fear to have over-rated the extent of my visual ray; and indeed every thing that can be said to shorten it will only contract the limits of our nebulæ, as it has in most places been of sufficient length to go far beyond the bounds of it. Thus in the sides of our stratum, opposite to our situation in it, where the gauges often run below 5, our nebulæ cannot extend to 100 times the distance of Sirius; and the same telescope which could show 588 stars in a field of view of 15 minutes, must certainly have presented me also with the stars in these situations, had they been there. If we should answer this by observing, that they might be at too great a distance to be perceived, it will be allowing that there must at least be a vacancy amounting to the length of a visual ray, not short of 400 times the distance of Sirius: and this is amply sufficient to make our nebulæ a detached one. It is true, that it would not be consistent confidently to affirm that we were on an island, unless we had found ourselves every where bounded by the ocean; and therefore I shall go no farther than the gauges will authorise: but considering the little depth of the stratum in all those places which have been actually gauged, to which must be added all the intermediate parts that have been viewed and found to be much like the rest, there is but little room to expect a connection between our nebula and any of the neighbouring ones. A telescope, with a much larger aperture than my present one, grasping together a greater quantity of light, and thereby enabling us to see farther into space, will be the surest means of completing and establishing the arguments that have been used: for if our nebula is not absolutely a detached one, I am firmly persuaded that an instrument may be made large enough to discover the places where the stars continue onwards. A very bright milky nebulosity must there undoubtedly come on, since the stars in a field of view will increase in the ratio of n^3 greater than that of the cube of the visual ray. Thus, if 588 stars in a given field of view are to be seen by a ray of 497 times the distance of Sirius, when this is lengthened to 1000, which is but little more than double the former, the number of stars in the same field of view will

224 Extent of our nebula.

Conclusions from the foregoing Appearances.

will be no less than 4774: for when the visual ray r is given, the number of stars S will be $=\frac{n^3}{B^3}$; where $n=r+1$; and a telescope with a threefold power of extending into space, or with a ray of 1500, which I think may easily be constructed, will give us 16,096 stars. Nor would these be so close, but that a good power applied to such an instrument might easily distinguish them; for they need not, if arranged in regular squares, approach nearer to each other than 6″.27: but the milky nebulosity I have mentioned, would be produced by the numberless stars beyond them, which, in one respect, the visual ray might also be said to reach. To make this appear, we must return to the naked eye; which, as we have before estimated, can only see the stars of the seventh magnitude so as to distinguish them: but it is nevertheless very evident, that the united lustre of millions of stars, such as I suppose the nebula in Andromeda to be, will reach our sight in the shape of a very small faint nebulosity; since the nebula of which I speak may easily be seen in a fine evening. In the same manner, my present telescope, as I have argued, has not only a visual ray that will reach the stars at 497 times the distance of Sirius, so as to distinguish them, and probably much farther, but also a power of showing the united lustre of the accumulated stars that compose a milky nebulosity at a distance far exceeding the former limits; so that from these considerations it appears again highly probable, that my present telescope not showing such a nebulosity in the milky-way, goes already far beyond its extent: and consequently much more would an instrument, such as I have mentioned, remove all doubt on the subject, both by showing the stars in the continuation of the stratum, and by exposing a very strong milky nebulosity beyond them, that could no longer be mistaken for the dark ground of the heavens.

225 Analogical arguments in favour of his doctrine.

"To these arguments, which rest on the firm basis of a series of observation, we may add the following considerations drawn from analogy. Among the great number of nebulæ which I have now already seen, amounting to more than 900, there are many which in all probability are equally extensive with that which we inhabit; and yet they are all separated from each other by very considerable intervals. Some, indeed, there are that seem to be double and treble; and though with most of these it may be that they are at a very great distance from each other, yet we allow that some such conjunctions really are to be found; nor is this what we mean to exclude. But then these compound, or double nebulæ, which are those of the third and fourth forms, still make a detached link in the great chain. It is also to be supposed, that there may be some thinly scattered solitary stars between the large interstices of nebulæ; which being situated so as to be nearly equally attracted by the several clusters when they were forming, remain unassociated: and though we cannot expect to see those stars on account of their vast distance, yet we may well presume that their number cannot be very considerable in comparison to those that are already drawn into systems: which conjecture is also abundantly confirmed in situations where the nebulæ are near enough to have their stars visible; for they are all insulated, and generally to be seen upon a very clear and pure ground, without any star near them that might be thought to belong to them. And though I have often seen them in beds of stars, yet from the size of these latter we may be certain, that they were much nearer to us than those nebulæ, and belonged undoubtedly to our own system.

Having thus determined that the visible system of nature, by us called the *universe*, consisting of all the celestial bodies and many more than can be seen by the naked eye, is only a group of stars or suns with their planets, constituting one of those patches called a *nebula*, and perhaps not one ten thousandth part of what is really the universe, Mr Herschel goes on to delineate the figure of this vast nebula, which he is of opinion may now be done; and for this purpose he gives a table, calculating the distance of the stars which form its extreme boundaries, or the length of the visual ray in different parts, by the number of stars contained in the field of his telescope at different times, according to the principles already laid down. He does not, however, as yet attempt the whole nebula, but of a particular section, represented fig. 160. "I have taken one (says he) which passes through the poles of our system, and is at rectangles to the conjunction of the branches, which I have called its *length*. The name of *poles* seemed to me not improperly applied to those points which are 90 degrees distant from a circle passing along the milky way; and the north pole is here supposed to be situated in right ascension 186°, and polar distance (that is from the pole commonly so called) 58°. The section is one which makes and angle of 35 degrees with our equator, crossing it in 124½ and 304½ degrees. A celestial globe, adjusted to the latitude of 55° north, and having σ Ceti near the meridian, will have the plane of this section pointed out by the horizon. The visual rays are to be projected on the plane of the horizon of the latitude just mentioned, which may be done accurately enough by a globe adjusted in the manner directed. The stars in the border, which are marked larger than the rest, are those pointed out by the gauges. The intermediate parts are filled up by smaller stars, arranged in straight lines between the gauged ones. From this figure, which I hope is not a very inaccurate one, we may see that our nebula, as we observed before, is of the third form; that is, a very extensive, branching, compound congeries of many millions of stars, which most probably owes its origin to many remarkably large, as well as pretty closely scattered small stars, that may have drawn together the rest. Now to have some idea of the wonderful extent of this system, I must observe, that this section of it is drawn upon a scale where the distance of Sirius is no more than the 80th part of an inch; so that probably all the stars, which in the finest nights we are able to distinguish with the naked eye, may be comprehended within a sphere drawn round the large star near the middle, representing our situation in the nebula of less than half a quarter of an inch radius."

226 How the figure of our nebula may be delineated.

Mr Herschel now proceeds to offer some further thoughts on the origin of the nebulous strata of the heavens; in doing which he gives some hints concerning the antiquity of them. "If it were possible (says he) to distinguish between the parts of an indefinitely extended whole, the nebula we inhabit might be said

to

Concluſions from the foregoing Appearances.

to be one that has fewer marks of antiquity than any of the reſt. To explain this idea perhaps more clearly, we ſhould recollect, that the condenſation of cluſters of ſtars has been aſcribed to a gradual approach; and whoever reflects on the number of ages that muſt have paſſed before ſome of the cluſters that are to be found in my intended catalogue of them could be ſo far condenſed as we find them at preſent, will not wonder if I aſcribe a certain air of youth and vigour to many very regularly ſcattered regions of our ſidereal ſtratum.

127 Of the decay and recompoſition of nebulæ.

There are, moreover, many places in it in which, if we may judge from appearances, there is the greateſt reaſon to believe that the ſtars are drawing towards ſecondary centres, and will in time ſeparate into cluſters, ſo as to occaſion many ſubdiviſions. Hence we may ſurmiſe, that when a nebulous ſtratum conſiſts chiefly of nebulæ of the firſt and ſecond forms, it probably owes its origin to what may be called the decay of a great compound nebula of the third form; and that the ſubdiviſions which happened to it in length of time, occaſioned all the ſmall nebulæ which ſprung from it to lie in a certain range, according as they were detached from the primary one. In like manner, our ſyſtem, after numbers of ages, may very poſſibly become divided ſo as to give riſe to a ſtratum of two or three hundred nebulæ; for it would not be difficult to point out ſo many beginning or gathering cluſters in it. This throws a conſiderable light upon that remarkable collection of many hundreds of nebulæ which are to be ſeen in what I have called the *nebulous ſtratum* in Coma Berenices. It appears from the extended and branching figure of our nebula, that there is room for the decompoſed ſmall nebulæ of a large reduced former great one to approach nearer to us in the ſides than in any other parts. Nay, poſſibly there might originally be another very large joining branch, which in time became ſeparated by the condenſation of the ſtars: and this may be the reaſon of the little remaining breadth of our ſyſtem in that very place; for the nebulæ of the ſtratum of the Coma are brighteſt and moſt crowded juſt oppoſite to our ſituation, or in the pole of our ſyſtem. As ſoon as this idea was ſuggeſted, I tried alſo the oppoſite pole; where accordingly I have met with a great number of nebulæ, though under a much more ſcattered form.

"Some parts of our ſyſtem indeed ſeem already to have ſuſtained greater ravages of time than others: for inſtance, in the body of the Scorpion is an opening or hole, which is probably owing to this cauſe. It is at leaſt four degrees broad; but its height I have not yet aſcertained. It is remarkable, that the 80 *Nebuleuſe ſans Etoiles* of the *Connoiſſance des Temps*, which is one of the richeſt and moſt compreſſed cluſters of ſmall ſtars I remember to have ſeen, is ſituated juſt on the weſt border of it, and would almoſt authoriſe a ſuſpicion that the ſtars of which it is compoſed were collected from that place, and had left the vacancy. What adds not a little to this ſurmiſe is, that the ſame phenomenon is once more repeated with the fourth cluſter of the *Connoiſſance des Temps*; which is alſo on the weſtern border of another vacancy, and has moreover a ſmall miniature cluſter, or eaſily reſolvable nebula, of about $2\frac{1}{2}$ minutes in diameter north, following it at no very great diſtance.

"There is a remarkable purity or clearneſs in the heavens when we look out of our ſtratum at the ſides; that is, towards Leo, Virgo, and Coma Berenices on one hand, and towards Cetus on the other; whereas the ground of the heavens becomes troubled as we approach towards the length or height of it. Theſe troubled appearances are eaſily to be explained by aſcribing them to ſome of the diſtant ſtraggling ſtars that yield hardly light enough to be diſtinguiſhed. And I have indeed often experienced this to be the cauſe, by examining theſe troubled ſpots for a long while together, when at laſt I generally perceived the ſtars which occaſioned them. But when we look towards the poles of our ſyſtem, where the viſual ray does not graze along the ſide, the ſtraggling ſtars will of courſe be very few in number: and therefore the ground of the heavens will aſſume that purity which I have always obſerved to take place in thoſe regions."

228 Univerſe compoſed of nebulæ.

Thus, then, according Mr Herſchel, the univerſe conſiſts of *nebulæ*, or innumerable collections of innumerable ſtars, each individual of which is a ſun not only equal, but much ſuperior to ours: at leaſt if the words of Mr Nicholſon have any weight; for he tells us, that "each individual ſun is deſtined to give light to *hundreds* of worlds that revolve about it, but which can no more be ſeen by us, on account of their great diſtance, than the ſolar planets can be ſeen from the fixed ſtars." "Yet (continues he), as in this unexplored, and perhaps unexplorable, abyſs of ſpace, it is no neceſſary condition that the planets ſhould be of the ſame magnitudes as thoſe belonging to our ſyſtem, it is not impoſſible but that planetary bodies may be diſcovered among the double and treble ſtars."

Nat. Phil. 165, 166. *Philad. Edit.*

Though in the above extracts from Mr Herſchel's papers, the words *condenſation*, *cluſters*, &c. of ſtars frequently occur, we are by no means from thence to imagine that any of the celeſtial bodies in our nebulæ are nearer to one another than we are to Sirius, whoſe diſtance is ſuppoſed not to be leſs than 400,000 times that of the ſun from us, or 38 millions of millions of miles. The whole extent of the nebula being in ſome places near 500 times as great, muſt be ſuch, that the light of a ſtar placed at its extreme boundary, ſuppoſing it to fly with the velocity of 12 millions of miles every minute, muſt have taken near 3000 years to reach us. Mr Herſchel, however, is by no means of opinion, that our nebula is the moſt conſiderable in the univerſe. "As we are uſed (ſays he to call the appearance of the heavens, where it is ſurrounded with a bright zone, the *milky-way*, it may not be amiſs to point out ſome other very remarkable nebulæ, which cannot well be leſs, but are probably much larger, than our own ſyſtem; and being alſo extended, the inhabitants of the planets that attend the ſtars which compoſe them, muſt likewiſe perceive the ſame phenomena: for which reaſon they may alſo be called *milky ways*, by way of diſtinction.

229 Of the ſize and diſtance of nebulæ.

"My opinion of their ſize is grounded on the following obſervations: There are many round nebulæ of the firſt form, of about five or ſix minutes in diameter, the ſtars of which I can ſee very diſtinctly; and on comparing them with the viſual ray calculated from ſome of my long guages, I ſuppoſe by the appearance of the ſmall ſtars in thoſe guages, that the centres of theſe round nebulæ may be 600 times the diſtance of Sirius

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Sirius from us."—He then goes on to tell us, that the stars in such nebulæ are probably twice as much condensed as those of our system; otherwise the centre of it would not be less than 6000 times the distance of Sirius from us; and that it is probably much underrated by supposing it only 600 times the distance of that star.

"Some of these round nebulæ (says Mr Herschel), have others near them, perfectly similar in form, colour, and the distribution of stars, but of only half the diameter: and the stars in them seem to be doubly crowded, and only at about half the distance from each other. They are indeed so small, as not to be visible without the utmost attention. I suppose these miniature nebulæ to be at double the distance of the first. An instance equally remarkable and instructive is a case where, in the neighbourhood of two such nebulæ as have been mentioned, I met with a third similar, resolvable, but much smaller and fainter nebula. The stars of it are no longer to be perceived; but a resemblance of colour with the former two, and its diminished size and light, may well permit us to place it at full twice the distance of the second, or about four or five times the distance of the first. And yet the nebulosity is not of the milky kind; nor is it so much as difficultly resolvable or colourless. Now in a few of the extended nebulæ, the light changes gradually, so as from the resolvable to approach to the milky kind; which appears to me an indication, that the milky light of nebulæ is owing to their much greater distance. A nebula, therefore, whose light is perfectly milky, cannot well be supposed to be at less than six or eight thousand times the distance of Sirius; and though the numbers here assumed are not to be taken otherwise than as very coarse estimates, yet an extended nebula, which in an oblique situation, where it is possibly foreshortened by one-half, two-thirds, or three-fourths of its length, subtends a degree or more in diameter, cannot be otherwise than of a wonderful magnitude, and may well out-vie our milky-way in grandeur."

Mr Herschel next proceeds to give an account of several remarkable nebulæ, and then concludes thus.

230 Vast length of time requisite to form the nebulæ.

"Now, what great length of time must be required to produce these effects (the formation of nebulæ) may easily be conceived, when, in all probablility, our whole system, of about 800 stars in diameter, if it were seen at such a distance that one end of it might assume the resolvable nebulosity, would not, at the other end, present us with the irresolvable, much less with the colourless and milky, sort of nebulosities." Great indeed must be the length of time requisite for such distant bodies to form combinations by the laws of attraction, since, according to the distances he has assumed, the light of some of his nebulæ must be thirty-six or forty-eight thousand years in arriving from them to us. It would be worth while then to inquire, whether *attraction* is a virtue propagated in time or not; or whether it moves quicker or slower than light?

231 Why the stars do not fall upon one another

In the course of Mr Herschel's observations and inquiries concerning the structure of the heavens, an objection occurred, that if the different systems were formed by the mutual attractions of the stars, the whole would be in danger of destruction by the falling of them one upon another. A sufficient answer to this, he thinks, is, that if we can really prove the system of the universe to be what he has said, there is no doubt but that the great Author of it has amply provided for the preservation of the whole, though it should not appear to us in what manner this is effected. Several circumstances, however, he is of opinion, manifestly tend to a general preservation; as, in the first place, the indefinite extent of the sidereal heavens; which must produce a balance that will effectually secure all the great parts of the whole from approaching to each other. "There remains then (says he) only to see how the particular stars belonging to separate clusters are prevented from rushing on to their centres of attraction." This he supposes may be done by projectile forces; "the admission of which will prove such a barrier against the seeming destructive power of attraction, as to secure from it all the stars belonging to a cluster, if not for ever, at least for millions of ages. Besides, we ought perhaps to look upon such clusters, and the destruction of a star now and then in some thousands of ages, as the very means by which the whole is preserved and renewed. These clusters may be the *laboratories* of the universe, wherein the most salutary remedies for the decay of the whole are prepared."

232 Of the planetary nebulæ.

In speaking of the planetary nebulæ, by which name he distinguishes those spots that are all over equally luminous, he says, "if we should suppose them to be single stars with large diameters, we shall find it difficult to account for their not being brighter, unless we should admit that the intrinsic light of some stars may be very much inferior to that of the generality; which, however, can hardly be imagined to extend to such a degree. We might suppose them to be comets about their aphelion, if the brightness, as well as magnitude of their diameters, did not oppose this idea: so that, after all, we can hardly find any hypothesis so probable as that of their being nebulæ; but then they must consist of stars that are compressed and accumulated in the highest degree. If it were not perhaps too hazardous to pursue a former surmise of a renewal in what I figuratively called the *Laboratories of the Universe*, the stars forming these extraordinary nebulæ, by some decay or waste of nature being no longer fit for their former purposes, and having their projectile forces, if any such they had, retarded in each others atmosphere, may rush at last together; and, either in succession, or by one general tremendous shock, unite into a new body. Perhaps the extraordinary and sudden blaze of a new star in Cassiopeia's chair, in 1572, might possibly be of such a nature. If a little attention to these bodies should prove that, having no annual parallax, they belong most probably to the class of nebulæ, they may then be expected to keep their station better than any one of the stars belonging to our system, on account of their being probably at a very great distance."

233 Motion of the fixed stars and solar system.

Having thus at length got through the conjectures and theories concerning the nature and situations of the heavenly bodies, we must now proceed to consider those projectile forces which are supposed necessary to the preservation of the system of Nature, and to prevent the stars from falling upon one another more frequently than they do. It was first suspected by Dr Halley, that many of the stars which we call *fixed*, are really in motion, though that motion is either so slow

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in itself, or their distance is so great, that it can scarce be perceptible in half a century. It is, however, now confirmed by astronomical observations, that Arcturus, Sirius, Aldebaran, Procyon, Castor, Rigel, Altair, and many others, are actually in motion: which consideration, with the length of time necessary to show any change of place in bodies at such extreme distance, with the lateness of any observations on this head, "would lead us (says Mr Herschel) to suppose that there is not one fixed star in the heavens: but "many other reasons (adds he) will render this so obvious, that there can hardly remain a doubt of the general motion of all the starry systems, and consequently of the solar one among the rest.

234 Attraction prevents the stars from remaining at absolute rest.

"I might begin with principles drawn from the theory of attraction, which evidently oppose every idea of absolute rest in any one of the stars, when once it is known that some of them are in motion, for the change that must arise by such motion, in the value of a power which acts inversely as the squares of the distances, must be felt in all the neighbouring stars; and if these be influenced by the motion of the former, they will again affect those that are next to them, and so on, till all are in motion. Now, as we know several stars in divers parts of the heavens do actually change their place, it will follow, that the motion of our solar system is not a mere hypothesis. And what will give additional weight to this consideration is, that we have the greatest reason to suppose most of those very stars which have been observed to move, to be such as are nearest to us; and therefore their influence on our situation would alone prove a powerful argument in favor of the proper motion of the sun had it been originally at rest."

After enumerating a great many changes, which, from his own observation, have happened among the fixed stars, and of which we have already given an account, "Does it not seem natural (says he), that these observations should cause a strong suspicion that most probably every star in the heaven is more or less in motion? And though we have no reason to think that the disappearance of some stars, or new appearance of others, nor indeed that the frequent changes in the magnitude of so many of them, are owing to their change of distance from us by proper motions, which could not occasion these phenomena without being inconceivably quick; yet we may well suppose, that motion is some way or other concerned in producing these effects. A slow motion, for instance, in an orbit round some large opaque body, where the star which is lost or diminished in magnitude might undergo occasional occultations, would account for some of those changes; while others might perhaps be owing to the periodical return of some large spots on that side of the surface which is alternately turned towards us by the rotatory motion of the star. The idea, also, of a body much flattened by a quick rotation, and having a motion similar to the moon's orbit by a change of the place of its nodes, whereby more of the luminous surface would one time be exposed to us than another, tends to the same end: for we cannot help thinking with M. de la Lande (Mem. 1776), that the same force which gave such rotations, would probably also produce motions of a different kind by a translation of the centre. Now, if the proper motion of the stars in general be once admitted, who can refuse to allow that our sun, with all its planets and comets, that is, the solar system, is no less liable to such a general agitation as we find to obtain among the rest of the celestial bodies?

235 Conjectures concerning the appearance of new stars

236 How to discover the proper motion of the sun.

"Admitting this for granted, the greatest difficulty will be, how to discern the proper motion of the sun among so many other and variously compounded motions of the stars. This is an arduous task indeed; but I shall point out a method of detecting the direction and quantity of the supposed proper motion of the sun by a few geometrical deductions; and at the same time show, by an application of them to some known facts, that we have already some reason to guess which way the solar system is probably tending its course.

"Suppose the sun to be at S. fig. 101, the fixed stars to be dispersed in all possible directions and distances around, at *s, s, s, s*, &c. Now, setting aside the proper motion of the stars, let us first consider what will be the consequence of a proper motion in the sun, and let it move in a direction from A towards B." Suppose it now arrived at C: here, by a mere inspection of the figure, it will be evident, that the stars *s, s, s*, which were before seen at *a a a*, will now, by the motion of the sun from S to C, appear to have gone in a contrary direction, and be seen at *b b b*; that is to say, every star will appear more or less to have receded from the point B, in the order of the letters *ab, ab, ab*. The converse of this proposition is equally true; for if the stars should all appear to have had a retrograde motion with respect to the point B, it is plain, on a supposition of their being at rest, the sun must have a direct motion towards the point B, to occasion all these appearances. From a due consideration of what has been said, we may draw the following inferences:

"1. The greatest, or total systematical parallax of the fixed stars (fig. 103), will fall upon those that are in the line D E, at rectangles to the direction A B of the sun's motion.

"2. The partial systematical parallax of every other star *s, s, s*, not in the line D E, will be to the total parallax as the sine of the angle BS*a*, being the star's distance from that point towards which the sun moves, to radius.

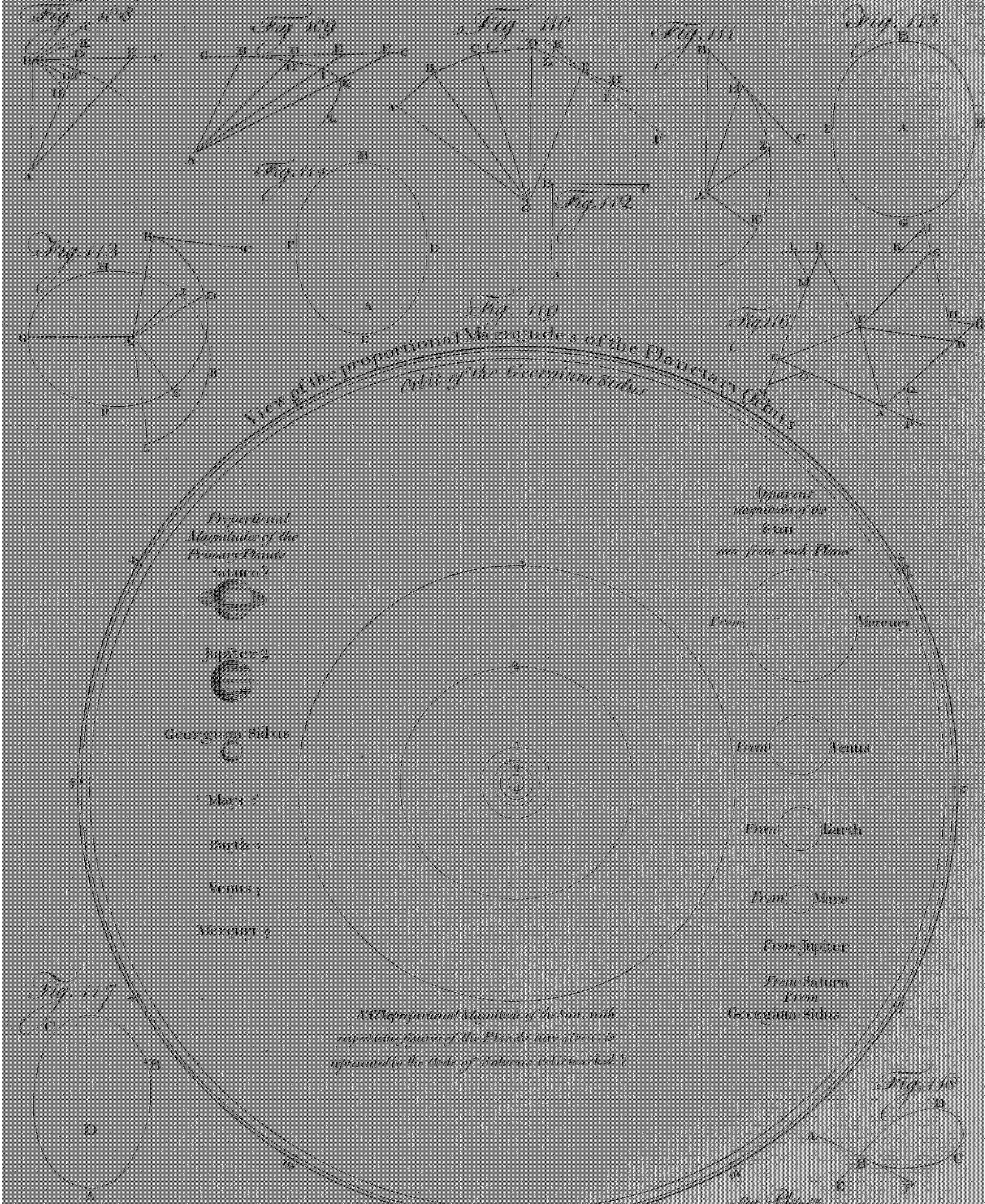
"3. The parallax of stars at different distances will be inversely as these distances; that is, one half at double the distance, one third at three times, and so on; for the subtense SC remaining the same, and the parallactic angle being very small, we may admit the angle S*s*C to be inversely as the side S*s*, which is the star's distance.

"4. Every star at rest, to a system in motion, will appear to move in a direction contrary to that which the system has. Hence it follows, that if the solar system be carried towards any star situated in the ecliptic, every star, whose angular distance in *antecedentia* (reckoned upon the ecliptic from the star towards which the system moves) is less than 180 degrees, will decrease in longitude; and that, on the contrary, every star, whose distance from the same star (reckoned upon the ecliptic, but *in consequentia*) is less than 180 degrees, will increase in longitude in both cases, without alteration of latitude.

The immense regions of the fixed stars may be considered as an infinitely expanded globe, having the so-

ASTRONOMY

Plate LXXI



Concluſions from the foregoing Appearances.

ſolar ſyſtem for its centre. The moſt proper method therefore of finding out the direction of the motion of the ſun is, to divide our obſervations on the ſyſtematical parallax of the fixed ſtars into three principal zones. Theſe, for the convenience of fixed inſtruments, may be aſſumed ſo as to let them paſs around the equator and the ſolſtitial colures, every one being at rectangles to the other two, according to the three dimenſions of ſolids." Our author, then, having informed us that obſervations on double ſtars are moſt proper for aſcertaining this point, gives an account of three zones he has marked out for this purpoſe; the equatorial zone, containing 150 double ſtars; that of the equinoctial colure, extending 10 degrees of a great circle on each ſide, as far as it is viſible on our hemiſphere, which will contain about 70 double ſtars; and that of the ſolſtitial colure, including 120, beſides a zone of the ecliptic containing a great many double ſtars which may undergo occultations by the moon. It is of the ſame extent, and includes about 120 double ſtars.

To apply this theory, it is neceſſary, in the firſt place to obſerve, that the rules of philoſophiſing direct us to refer all phenomena to as few and ſimple principles as are ſufficient to explain them. Aſtronomers, therefore, having already obſerved what they call a proper motion in ſeveral of the fixed ſtars, and which may be ſuppoſed common to them all, ought to reſolve it, as far as poſſible, into a ſingle and real motion of the ſolar ſyſtem, as far as that will anſwer the known facts, and only to attribute to the proper motion of each particular ſtar the deviations from the general law which the ſtars ſeem to follow.

237 Proper motions of ſome of the ſtars.

Dr Maſkelyne informs us, that the proper motions in right aſcenſion of Sirius, Caſtor, Procyon, Pollux, Regulus, Arcturus, and α Aquilæ, are as follow.—0″.63;— 0″.28; 0″.80—0″.93;— 0″.41;— 1″.40, and + 0″.57. Two of them, Sirius and Arcturus, have alſo a change of declination; viz. 1′.20 and 2″.01; both ſouthward. Let now fig. 104. repreſent an equatorial zone with the abovementioned ſtars referred to it, according to their reſpective right aſcenſions, having the ſolar ſyſtem in its centre. Aſſume the direction AB from a point ſomewhere not far from the 77th degree of right aſcenſion to its oppoſite 257th degree, and ſuppoſe the ſun to move in that direction from S towards B, then will that one motion anſwer that of all the ſtars together; for if the ſuppoſition be true, Arcturus, Regulus, Pollux, Procyon, Caſtor, and Sirius, ſhould appear to decreaſe in right aſcenſion, while α Aquilæ, on the contrary, ſhould appear to increaſe. Moreover, ſuppoſe the ſun to aſcend at the ſame time, in the ſame direction, towards ſome point in the northern hemiſphere, for inſtance towards the conſtellation Hercules; then will alſo the obſerved change of declination of Sirius and Arcturus be reſolved into the ſingle motion of the ſyſtem. Many difficulties indeed yet remain; ſuch as the correſpondence of the exact quantity of motion obſerved in each ſtar, with what will be aſſigned to it by this hypotheſis. But it is to be remembered, that the very different and ſtill unknown diſtances of the fixed ſtars muſt, for a good while yet, leave us in the dark as to the ſtrict application of the theory; and that any deviation from it may eaſily be accounted for from the ſtill unknown *real* proper motion of the ſtars; for if the ſolar ſyſtem have in reality the motion now aſcribed to it, then what aſtronomers have already obſerved concerning the change of place of the ſtars, and have called their proper motion, will become only an *apparent* motion; and future obſervations muſt ſtill point out, by the deviations from the general law, which the ſtars will follow in thoſe apparent motions, what may be their real proper motions, as well as relative diſtances. "But (ſays Mr Herſchel) leſt I ſhould be cenſured for admitting ſo new and capital a motion upon too ſlight a foundation, I muſt obſerve that the concurrence of thoſe ſeven principal ſtars cannot but give ſome value to an hypotheſis that will ſimplify the celeſtial motions in general. We know that the ſun, at the diſtance of a fixed ſtar, would appear like one of them; and from analogy we conclude the fixed ſtars to be ſuns. Now, ſince the apparent motions of thoſe ſeven ſtars may be accounted for, either by ſuppoſing them to move in the manner they appear to do, or elſe by ſuppoſing the ſun alone to have a motion in a direction ſome how not far from that which I have aſſigned to it, I think we are no more authoriſed to ſuppoſe the ſun at reſt than we ſhould be to deny the diurnal motion of the earth; excepting in this reſpect, that the proofs of the latter are very numerous, whereas the former reſt only on a few, though capital teſtimonies."

238 Change of right aſcenſion and declination of twelve ſtars.

The following table, taken from De la Lande, of the change of right aſcenſion and declination of twelve ſtars, is brought as an additional proof of this doctrine.

Names of Stars.	Change of R. A.			Change of Declin.		
Arcturus	—	1′	11″	—	1′	55″
Sirius	—		37	—		52
β Cygni	—		3	+		49
Procyon	—		33	—		47
ε Cygni	+		20	+		34
γ Arietis	—		14	—		29
γ Gemini	—		8	—		24
Aldebaran	+		3	—		18
β Gemini	—		48	—		16
γ Piſcium	+		53	+		7
α Aquilæ	+		32	—		4
α Gemini	—		24	—		1

Fig. 105. repreſents them projected on the plane of the equator. They are all in the northern hemiſphere except Sirius, which muſt be ſuppoſed to be viewed in the concave part of the oppoſite half of the globe, while the reſt are drawn on the convex ſurface. Regulus being added to that number, and Caſtor being double, we have 14 ſtars; and every ſtar's motion, except Regulus, being aſſigned in declination as well as right aſcenſion, we have no fewer than 27 given motions to account for. Now, by aſſuming a point ſomewhere near λ Herculis, and ſuppoſing the ſun to have a proper motion towards that part of the heavens, we ſhall account for 22 of theſe motions. For β Cygni, α Aquilæ, ε Cygni, γ Piſcium, γ Arietis, and Aldebaran, ought, upon the ſuppoſed motion of the ſun, to have an apparent progreſſion according to the hour-circle XVIII, XIX, XX, &c. or to increaſe in right aſcenſion; while Arcturus, Regulus, the two ſtars of α Geminorum, Pollux, Procyon, Sirius, and γ Geminorum, ſhould apparently go back in the order XVI, XV, XIV, &c. of the hour-circle, ſo as to decreaſe in right aſcenſion. But according to De la Lande's table, excepting β Cygni and γ Arietis, all theſe mo-

239 Motions of the ſtars accounted for.

tions

Conclusions from the foregoing Appearances.

tions really take place. With regard to the change of declination, every star in the table should go towards the south; and here we find but three exceptions, in β and ε Cygni and γ Piscium. So that, upon the whole, we have but five deviations out of 27 known motions, which this hypothesis will not account for; and these exceptions must be resolved into the real proper motion of the stars.

240 Of the velocity of the stars.

Some circumstances in the quantity of these motions also deserve our notice. In the first place, Arcturus and Sirius being the largest of the stars, and therefore probably the nearest, ought to have the greatest apparent motion, both in right ascension and declination; which is agreeable to observation, as appears from the table. 2. With regard to the right ascension only, Arcturus being better situated to show its motion, ought to have it much greater; as we find it actually has. Aldebaran, both badly situated and considerably smaller, ought, according to the same rule, to show but little motion, &c.; all of which is conformable to the table. A very striking agreement with the hypothesis may be also observed in Castor and Pollux, both of which are pretty well situated; and accordingly we find that Pollux, for the size of the star, shows as much motion in right ascension as we could expect; though it is remarkable that Castor, though equally well placed, shows no more than half the motion by the table. This is seemingly contrary to the hypothesis: but it must be remembered, that Castor is a double star, and the two of which it consists are nearly equal to each other in lustre; so that, as we can allow only half the light to each, there is a strong presumption of their being at twice the distance of Pollux, which agrees very well with observation. It might also be observed, that we should be involved in great difficulty by supposing the motion of Castor really to be in the star: for how extraordinary must be the concurrence, that two stars, viz. those that make up this apparently single one, should both have a proper motion so exactly alike, that in all our observations hitherto, we have not found them disagree a single second either in right ascension or in declination for 50 years together?

241 Arguments from the observations of Mr Mayer in favour of Herschel's hypothesis

In a postscript to this paper on the motion of the solar system, Mr Herschel brings several additional confirmations of his hypothesis from the works of Mr Mayer. These contain a catalogue of the places of 80 stars observed by Mr Mayer in 1756, and whose places he compared with those of the same stars given by Roemer in 1706. From the goodness of the instrument with which Mr Roemer made his observations, Mr Mayer gives it as his opinion, that where the disagreement in the place of a star is but small, it may be attributed to the imperfection of the instrument; but that when it amounts to 10″ or 15″, it is a very probable indication of motion in such a star; and he adds, that when the disagreement is so much as in some stars which he names (among which is *Fomahand*, where the difference is 21″ in 50 years), he has not the least doubt of a proper motion. The following tables are extracted from Mr Mayer's work; one contains the stars

242 Tables of moving stars.

whose motion agrees with Mr Herschel's hypothesis; the other those that disagree with it, and whose phenomena must therefore be either ascribed to a proper motion of the stars themselves, or to some other more hidden cause.

Conclusions from the foregoing Appearances.

TABLE I.

Names of Stars.	Motion in R. A.	Motion in Declin.
β Ceti	+ 32	- -
α Arietis	+ 10	- -
δ Ceti	+ 15	- -
α Ceti	+ 16	- -
α Persei	+ 16	- -
η Pleiadum	- -	— 16
γ Eridani	+ 14	- -
ε Tauri	- -	— 11
α Aurigæ	+ 11	— 11
β Orionis	insens.	insens.
β Tauri	— 11	— 13
ζ Hydræ	— 23	- -
γ Leporis	- -	— 10
ε Ursæ Majoris	— 33	+ 10
α Serpentis	insens.	- -
γ Draconis	+ 12	- -
α Lyræ	insens.	+ 14
γ Aquilæ	- -	— 20
γ Capricorn	+ 19	- -
ε Pegasi	- -	— 28
δ Capricorn	+ 24	— 17
α Aquar.	+ 13	- -
α Orionis	insens.	— 11
μ Geminorum	— 16	- -
ρ Navis	— 13	— 11
β Cancri	- -	— 14
ι Ursa Majoris	— 54	- -
ζ Pegasi	- -	— 13
Fomahand	+ 21	- -
β Pegasi	+ 12	- -
α Androm.	- -	— 21
β Cassiopeiæ	+ 34	- -

TABLE II.

Names of Stars.	Motion in R. A.	Motion in Declin.
Polaris	- -	+ 13
γ Ceti	— 14	- -
β Persei	— 10	- -
α Leporis	- -	+ 11
μ Geminor.	- -	+ 15
ε Canis Major	- -	+ 10
ζ Hydræ	- -	+ 24
α Hydræ	- -	+ 13
β Herculis	+ 14	- -
γ Cygni	— 13	- -
ε Pegasi	— 14	- -
ζ Pegasi	— 20	- -

"From the first table, (says Mr Herschel), we gather that the principal stars, Lucida, Lyræ, Capella, α Orionis, Rigel, Fomahand, α Serpentarii, α Aquarii, α Arietis, α Persei, α Andromedæ, α Tauri, α Ceti, and 20 more of the most distinguished of the second and third rank of the stars, agree with our proposed solar motion, when, on the contrary, the second table contains but a few stars, and not a single one of the first magnitude among them to oppose it. It is also remarkable, that many stars of the first table agree both in right ascension and declination with the supposition of a solar motion; whereas there is not one among those of the second table which opposes it in both directions. This seems to indicate, that the solar motion, in some

of

Conclusions from the foregoing Appearances.

of them at least, has counteracted and thereby destroyed, the effect of their own proper motion in one direction, so as to render it insensible; otherwise it would appear improbable, that eight stars out of twelve, contained in the latter table should only have a motion at rectangles, or in opposition to any one given direction. The same may also be said of 19 stars of the former table, that only agree with the solar motion one way, and are as to sense at rest in the other direction; but these singularities will not be near so remarkable when we have the motion of the sun to compound with their own proper motions.

The motions of α Lyræ and ι Ursæ Majoris towards the north, are placed in the first table: to understand the reason of which, it will be necessary to point out the general law by which the apparent declinations of
243 the stars at present under consideration are governed. Let an arch of 90° be applied to a sphere representing the fixed stars, so as always to pass through the apex of the solar motion: then, while one end of it is drawn along the equator, the other will describe on the spherical surface a curve which will pass through the pole of the equator, and return into itself at the apex. This

243 To delineate the apparent motions of the stars.

244 curve, not taken notice of by other authors, Mr Herschel calls a *spherical conchoid*, from the manner in which it is generated. The law then is, that all the stars in the northern hemisphere, situated within the nodated part of the conchoid, will seem to go to the north by the motion of the solar system towards its apex, the rest will appear to go southwards. A similar curve is to be delineated in the southern hemisphere. Mr Herschel then shows a method of finding whether any star, whose place in the heavens is known, will fall without or within the conchoid; after which he accounts for the want of sensible motion in α Lyræ and α Orionis in right ascension, and of Rigel both in right ascension and declination, in the following manner: "These stars are so bright, that we may reasonably suppose them to be among those that are nearest to us; and if they had any considerable motion, it would most likely have been discovered, since the variations of Sirius, Arcturus, Procyon, Castor, and Pollux, &c. have not escaped our notice. Now, from the same principle of the motion of the solar system, by which we have accounted for the apparent *motion* of the latter stars, we may account for the apparent *rest* of the former. Those two bright stars, α Lyræ and α Orionis, are placed so near the direction of the assigned solar motion, that from the application of the second theorem (n° 236), their motion ought to be insensible in right ascension, and not very considerable in declination; all which is confirmed by observations. With respect to Rigel and α Serpentarii, admitting them both as stars large enough to have shown a proper motion, were their situation otherwise than it is, we find that they also should be apparently at rest in right ascension; and Rigel, having southern declination, and being a less considerable star than α Orionis, which shows but 11″ motion towards the south in 50 years, its apparent motion in declination may on that account be also too small to become visible." Our author concludes with a remarkable passage from Mayer, to the following purpose, viz. "if it be possible that the sun has any proper motion of his own, the stars in that part of the heavens towards which he moves, must appear to open and recede from each other, while on the other hand, those on the opposite side will seem to contract their distances, and come nearer each other." "Now (says Mr Herschel), if we recollect what has been said of the motion of the stars, we find that those towards which I suppose the solar system to move, do really recede from each other: for instance, Arcturus from α Lyræ, α Aquilæ and α Aquarii from α Serpentarii and ε Ursæ Majoris; and, on the contrary, those in the opposite part of the heavens do really come nearer each other, as Sirius to Aldebaran, Procyon to α Arietis, Castor, Pollux, Regulus, &c. to α Ceti, α Persei, α Andromedæ, &c. It must be added however, that we cannot expect immediately to perceive any effects of this motion, excepting in such stars as are nearest to us. But as we have at present no other method of judging of the relative distance of the fixed stars than from their apparent brightness, those that are most likely on that account to be affected by a parallax arising from the motion of the solar system, are the very stars which have been pointed out from Mayer's own table."

244 Spherical conchoid described.

245 Velocity of the solar system.

With regard to the quantity of motion in the solar system, or the velocity with which the sun and planets change their places in absolute space, Mr Herschel proposes only a few distant hints. "From the annual parallax of the fixed stars (says he), which from my own observations I find much less than it has hitherto been thought to be, we may certainly admit that the diameter of the earth's orbit, at the distance of Sirius or Arcturus, would not nearly subtend an angle of one second; but the apparent motion of Arcturus, if owing to a translation of the solar system, amounts to no less 2″.7 a-year, as will appear if we compound the two motions of 1′ 11″ in right ascension, and 1′ 55″ in declination into one single motion, and reduce it into an annual quantity. Hence we may, in a general way estimate, that the solar motion can certainly not be less than that which the earth has in her annual orbit."

Sect. IV. *Of the different Systems by which the Celestial Phenomena have been accounted for.*

In treating of the various systems which have been invented in different ages, we do not mean to give an account of the various absurdities that have been broached by individuals on this subject; but shall confine ourselves to those systems which have been of considerable note, and been generally followed for a number of years. Concerning the opinions of the very first astronomers about the system of nature, we are necessarily as ignorant as we are of those astronomers themselves. Whatever opinions are handed down to us, must be of a vastly later date than the introduction of astronomy among mankind. If we may hazard a conjecture, however, we are inclined to think that the first opinions on this subject were much more just than those that were held afterwards for many ages. 246
We are told that Pythagoras maintained the motion of the earth, which is now universally believed, but at that time appears to have been the opinion of only a few detached individuals of Greece. As the Greeks borrowed many things from the Egyptians, and Pythagoras had travelled into Egypt and Phenice, it is probable he might receive an account of this hypothesis from thence; but whether he did so or not, we have

246 Pythagorean system

Of the different systems by which the Celestial Phenomena have been accounted for.

now no means of knowing, neither is it of any importance whether he did or not. Certain it is, however, that this opinion did not prevail in his days, nor for many ages after. In the 2d century after Christ, the very name of the Pythagorean hypothesis was suppressed by a system erected by the famous geographer and astronomer Claudius Ptolemæus. This system, which commonly goes by the name of the *Ptolemaic*, he seems not to have originally invented, but adopted as the prevailing one of that age; and perhaps made it somewhat more consistent than it was before. He supposed the earth at rest in the centre of the universe. Round the earth, and the nearest to it of all the heavenly bodies, the moon performed its monthly revolutions. Next to the moon was placed the planet Mercury; then Venus; and above that the Sun, Mars, Jupiter, and Saturn, in their proper orbits; then the sphere of the fixed stars; above these, two spheres of what he called *chrystalline* heavens; above these was the primum mobile, which, by turning round once in 24 hours, by some unaccountable means or other, carried all the rest along with it. This primum mobile was encompassed by the empyrean heaven, which was of a cubic form, and the seat of angels and blessed spirits. Besides the motions of all the heavens round the earth once in 24 hours, each planet was supposed to have a particular motion of its own; the moon, for instance, once in a month, performed an additional revolution, the sun in a year, &c. See Fig. 150.

247 Suppressed by the Ptolemaic.

248 Ptolemy's system insufficient.

It is easy to see, that, on this supposition, the confused motions of the planets already described could never be accounted for. Had they circulated uniformly round the earth, their apparent motion ought always to have been equal and uniform, without appearing either stationary or retrograde in any part of their courses. In consequence of this objection Ptolemy was obliged to invent a great number of circles, interfering with each other, which he called *epicycles* and *eccentrics*. These proved a ready and effectual salvo for all the defects of his system; as whenever a planet was deviating from the course it ought on his plan to have followed, it was then only moving in an epicycle or an eccentric, and would in due time fall into its proper path. As to the natural causes by which the planets were directed to move in these epicycles and eccentrics, it is no wonder that he found himself much at a loss, and was obliged to have recourse to divine power for an explanation, or, in other words, to own that his system was unintelligible.

249 Pythagorean system revived by Copernicus

This system continued to be in vogue till the beginning of the 16th century, when Nicolaus Copernicus, a native of Thorn (a city of regal Prussia), and a man of great abilities, began to try whether a more satisfactory manner of accounting for the apparent motions of the heavenly bodies could not be obtained than was afforded by the Ptolemaic hypothesis. He had recourse to every author upon the subject, to see whether any had been more consistent in explaining the irregular motions of the stars than the mathematical schools: but he received no satisfaction, till he found first from Cicero, that Nicetas the Syracusan had maintained the motion of the earth; and next from Plutarch, that others of the ancients had been of the same opinion. From the small hints he could obtain from the ancients, Copernicus then deduced a most complete system, capable of solving every phenomenon in a satisfactory manner. From him this system hath ever afterwards been called the *Copernican*, and represented fig. 152. Here the sun is supposed to be in the centre; next him revolves the planet Mercury, then Venus; next, the Earth, with the Moon; beyond these, Mars, Jupiter, and Saturn; and far beyond the orbit of Saturn, he supposed the fixed stars to be placed, which formed the boundaries of the visible creation.

250 Tychonic system.

Though this hypothesis afforded the only natural and satisfactory solution of the phenomena which so much perplexed Ptolemy's system, it met with great opposition at first; which is not to be wondered at, considering the age in which he lived. Even the famous astronomer Tycho Brache could never assent to the earth's motion, which was the foundation of Copernicus's scheme. He therefore invented another system, whereby he avoided the ascribing of motion to the earth, and at the same time got clear of the difficulties with which Ptolemy was embarrassed. In this system, the earth was supposed the centre of the orbits of the sun and moon; but the sun was supposed to be the centre of the orbits of the five planets; so that the sun with all the planets were by Tycho Brache supposed to turn round the earth in order to save the motion of the earth round its axis once in 24 hours. This system was never much followed, the superiority of the Copernican scheme being evident at first sight. Fig. 151.

251 Inquiries concerning the causes of the planetary motions.

The system of Copernicus coming soon into universal credit, philosophers began to inquire into the causes of the planetary motions; and here, without entering upon what has been advanced by detached individuals, we shall content ourselves with giving an account of the three famous systems, the Cartesian, the Newtonian, and what is sometimes called the *Mechanical* system.

252 Cartesian system.

Des Cartes, the founder of that system which since his time has been called the *Cartesian*, flourished about the beginning of the 17th century. His system seems to have been borrowed from the philosophers Democritus and Epicurus; who held, that every thing was formed by a particular motion of very minute bodies called *atoms*, which could not be divided into smaller parts. But though the philosophy of Des Cartes resembled that of the Corpuscularians, in accounting for all the phenomena of nature, merely from matter and motion; he differed from them in supposing the original parts of matter capable of being broken. To this property his *Materia Subtilis* owes its origin. To each of his atoms, or rather small masses of matter, Des Cartes attributed a motion on its axis, and likewise maintained that there was a general motion of the whole matter of the universe round like a vortex or whirlpool. From this complicated motion, those particles which were of an angular form, would have their angles broke off, and the fragments which were broke off being smaller than the particles from which they were abraded, behoved to form a matter of a more subtile kind than that made of large particles; and as there was no end of the abrasion, different kinds of mattter of all degrees of fineness would be produced. The finest sorts, he thought, would naturally separate themselves from the rest, and be accumulated in particular places. The finest of all would therefore be collected in the sun which was the centre of the universe, whose vortex was the whole etherial matter in the creation.

ASTRONOMY.

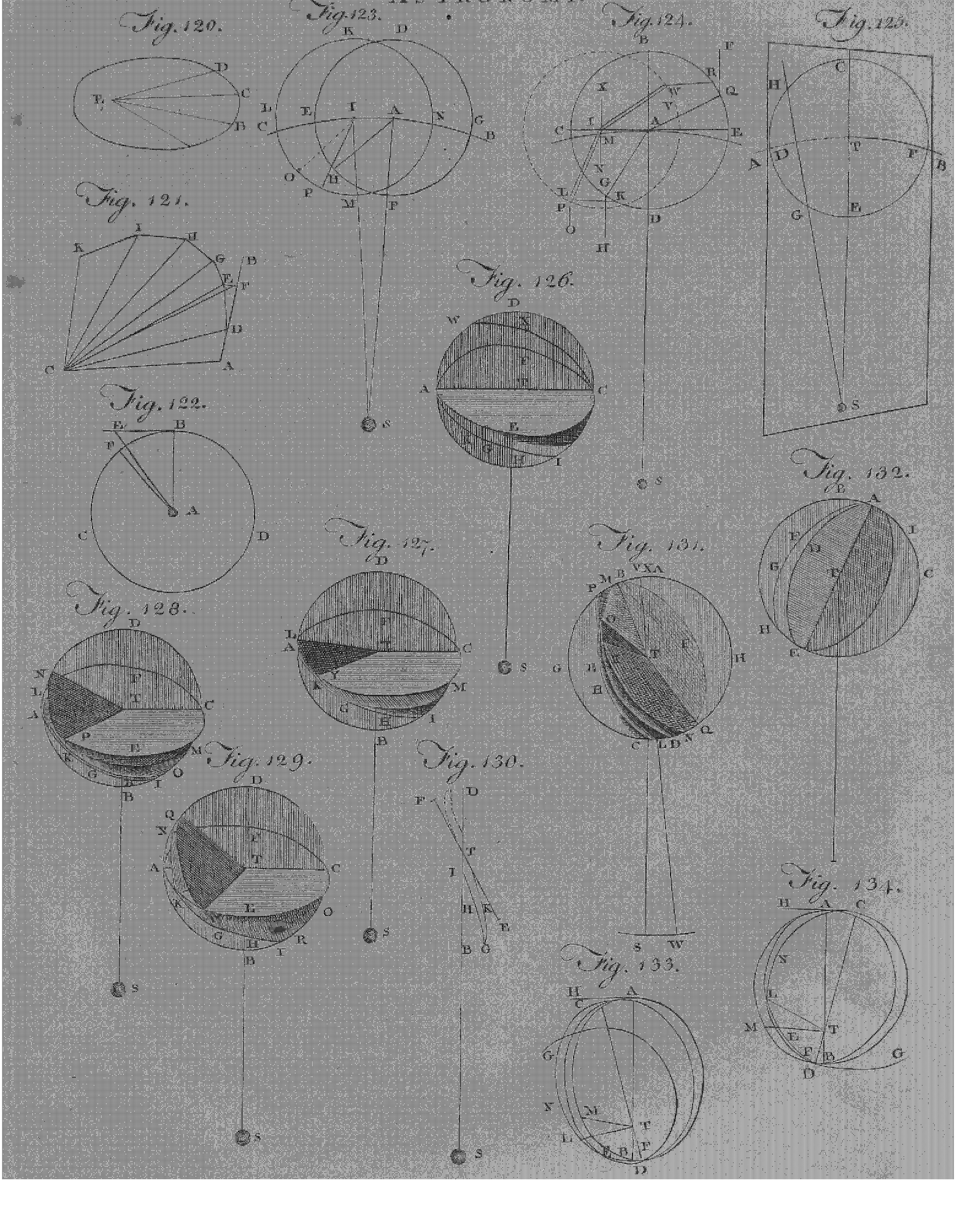


Fig. 120.
Fig. 121.
Fig. 122.
Fig. 123.
Fig. 124.
Fig. 125.
Fig. 126.
Fig. 127.
Fig. 128.
Fig. 129.
Fig. 130.
Fig. 131.
Fig. 132.
Fig. 133.
Fig. 134.

Of the different systems by which the Celestial Phenomena have been accounted for.

ation. As all the planets were immersed in this vortex, they behoved to be carried round by it, in different times, proportioned to their distances; those which were nearest the sun circulating the most quickly; and those farthest off more slowly; as those parts of a vortex which are farthest removed from the centre are observed to circulate more slowly than those which are nearest. Besides this general vortex of the sun, each of the planets had a particular vortex of their own by which their secondary planets were carried round, and any other body that happened to come within reach of it would likewise be carried away.

It is easy to see, from this short account of Des Cartes's system, that the whole of it was mere *petitio principii*: for had he been required to prove the existence of his materia subtilis, he must undoubtedly have failed in the attempt; and hence, though his hypothesis was for some time followed for want of a better, yet it gave way to that of Newton almost as soon as it was proposed.

253 Sir Isaac Newton's system, (fig. 119.)

THE general view of the solar system given by this celebrated philosopher is not different from what has been laid down in the foregoing sections. The sun is placed in or near the centre; about whom the six planets, to which a seventh, the *Georgium Sidus*, is now added, continually move with different degrees of velocity, and at different distances. The first and nearest to the sun is Mercury, next Venus, then the Earth and Moon: beyond these is Mars; after him, Jupiter; then Saturn; and last of all, at least as far as discoveries have hitherto reached, the *Georgium Sidus*. Four of these primary planets, as they are called, are attended by moons or satellites, as well as the earth. These are, Venus* Jupiter, Saturn, and the Georgium Sidus: of whom the first has only one; the second, four; the third, five; and the fourth two, though probably there may be more yet undiscovered by reason of their smallness or distance.

* See n° 74.

254 Orbits of the planets elliptical, &c.

Though these planets uniformly and at all times respect the sun as the centre of their motion, yet they do not always preserve the same distance from him; neither do they all move in the same plane, though every one of them revolves in an orbit whose plane if extended would pass through the sun's centre. The line in which the planes of any of the planetary orbits crosses the orbit of the earth is called the *line* of its nodes, and the points of intersection are the *nodes* themselves. Each of them moves in an orbit somewhat elliptical; and thus sometimes approaches nearer, and at others recedes farther from, the sun than before. This deviation from a circle is called the *eccentricity* of the orbit; the point where it is farthest distant from the sun is called its *aphelion*; and where nearest, the *perihelion*. The eccentricities of the different planets, however, are very different. In Saturn the proportion of the greatest distance to the least is something less than 9 to 8, but much nearer to this than 10 to 9; in Jupiter, it is something greater than that of 11 to 10; in Mars, it exceeds the proportion of 6 to 5; in the earth, it is only in the proportion of about 30 to 29; in Venus still less, being only as 70 to 69; but in Mercury it is much greater than in any of the rest, being little less than that of 3 to 2. The aphelia of all the planets are not situated on the same side of the sun, but in the positions shown fig. 106. though

255 Eccentricities, aphelia, &c. of the different planets.

these positions are also variable, as shall be afterwards more fully explained. The eccentricity of the Georgium Sidus is not yet determined, though it is supposed to be less than that of the rest. All of them revolve from west to east; and the most remote is the longest of finishing its course round the sun.

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256 They describe equal spaces in equal times round the sun.

Each of the planets moves in its orbit round the sun in such a manner, that the line drawn from the sun to the planet, by accompanying the planet in its motion, will describe about the sun equal spaces in equal times. There is also a certain relation between the greater axes of these ellipses and the times in which the planets perform their revolutions through them, which may be expressed in the following manner: Let the period of one planet be expressed by the letter A, the greater axis of its orbit by D; let the period of another planet be denoted by B, and the greater axis of this planet's orbit by E. Then if C be taken to bear the same proportion to B as B bears to A; likewise if F be taken to bear the same proportion to E as E bears to D, and G taken to bear the same proportion likewise to F as E bears to D; then A shall bear the the same proportion to C as D bears to G.

A D
B E
C F
G

§ 1. *Of Centripetal Powers in general.*

257 Sir Isaac's doctrine of centripetal powers.

BEFORE we attempt to give any particular explanation of the causes producing the planetary motions, it will be necessary to premise something of Sir Isaac Newton's doctrine of centripetal forces, as upon that depends his doctrine of gravitation, and of the whole celestial system. The first effect of these powers is, to cause any body projected in a straight line deviate from it, and describe an incurvated one, which shall always be bent towards the centre to which the body is supposed to have a tendency. It is not, however, necessary that the moving body should approach the centre; it may even recede farther from it notwithstanding its being drawn by it; but this property uniformly belongs to it, that the line in which it moves will be continually concave towards the centre to which the power is directed.

Let A (fig. 107.) be the centre of the force. Let a body in B be moving in the direction of the straight line BC, in which line it would continue to move if undisturbed; but being attracted by the centripetal force towards A, the body must necessarily depart from this line BC; and being drawn into the curve line BD, must pass between the lines AB and BC. It is evident, therefore, that the body in B being gradually turned off from the straight line BC, it will at first be convex towards that line and concave towards A. And that the curve will always continue to have this concavity towards A, may thus appear: In the line BC, near to B, take any point, as E, from which the line EFG may be so drawn as to touch the curve line BD in some point, as F. Now, when the body is come to E, if the centripetal power were immediately to be suspended, the body would no longer continue to move in a curve line, but, being left to itself, would forthwith reassume a straight course, and that straight course would be in the line FG; for that line is in the direction of the body's motion of the point F. But the centripetal force continuing its energy, the body will be gradually drawn from this line FG so as to keep in the

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the line FD, and make that line, near the point F, to be concave towards the point A; and in this manner the body may be followed in its course throughout the line BD, and every part of that line be shown to be concave towards the point A.

Again, the point A (fig. 108.) being the centre of a centripetal force, let a body at B set out in the direction of the straight line BC perpendicular to the line AB. It will be easily conceived, that there is no other point in the line BC so near to A as the point B; that AB is the shortest of all the lines which can be drawn from A to any part of the line BC; all others, as AD or AE, being longer than AB. Hence it follows, that the body setting out from it, if it moved in the line BC, it would recede more and more from the point A. Now, as the operation of a centripetal force is to draw a body towards the centre of that force, if such a force act upon a resting body, it must necessarily put that body so into motion as to cause it move towards the centre of the force: if the body were of itself moving towards that centre, it would accelerate that motion, and cause it to move faster down; but if the body were in such a motion that it would of itself recede from the centre, it is not necessary that the action of a centripetal power should make it immediately approach the centre from which it would otherwise have receded; the centripetal force is not without effect if it cause the body to recede more slowly from that centre than otherwise it would have done. Thus, the smallest centripetal power, if it act on the body, will force it out of the line BC, and cause it to pass in a bent line between BC and the point A, as has been already explained. When the body, for instance, has advanced to the line AD, the effect of the centripetal force discovers itself by having removed the body out of the line BC, and brought it to cross the line AD somewhere between A and D, suppose at F. Now, AD being longer than AB, AF may also be longer than AB. The centripetal power may indeed be so strong, that AF shall be shorter than AB; or it may be so evenly balanced with the progressive motion of the body that AF and AB shall be just equal; in which case the body would describe a circle about the centre A; this centre of the force being also the centre of the circle.

If now the body, instead of setting out in the line BC perpendicular to AB, had set out in another line BG more inclined towards the line AB, moving in the curve line BH; then, as the body, if it were to continue its motion in the line BG, would for some time approach the centre A, the centripetal force would cause it to make greater advances toward that centre: But if the body were to set out in the line BI, reclined the other way from the perpendicular BC, and were to be drawn by the centripetal force into the curve line BK; the body, notwithstanding any centripetal force, would for some time recede from the centre; since some part at least of the curve line BK lies between the line BI and the perpendicular BC.

Let us next suppose a centripetal power directed toward the point A (Fig. 109.), to act on a body in B, which is moving in the direction of the straight line BC, the line BC reclining off from AB. If from A the straight lines AD, AE, AF, are drawn to the line CB, prolonged beyond B to G, it appears that AD is inclined to the line GC more obliquely than AB, AE more obliquely than AD, and AF than AE; or, to speak more correctly, the angle under ADG is less than that under ABG, that under AEG is less than ADG, and AFG less than AEG. Now suppose the body to move in the curve line BHIK, it is likewise evident that the line BHIK being concave towards A and convex towards BC, it is more and more turned off from that line: so that in the point H, the line AK will be more obliquely inclined to the curve line BHIK than the same line AHD is inclined to BC at the point D; at the point I the inclination of the line AI to the curve line will be more different from the inclination of the same line AIE to the line BC at the point IE; and in the points K and F the difference of inclination will be still greater; and in both, the inclination at the curve will be less oblique than at the straight line BC. But the straight line AB is less obliquely inclined to BG than AD is inclined towards DG: therefore, although the line AH be less obliquely inclined towards the curve HB than the same line AHD is inclined towards DG, yet it is possible, that the inclination at H may be more oblique than the inclination at B. The inclination at H may indeed be less oblique than the other, or they may be both the same. This depends upon the degree of strength wherewith the centripetal force exerts itself during the passage of the body from B to H; and in like manner the inclinations at I and K depend entirely on the degree of strength wherewith the centripetal force acts on the body in its passage from H to K: if the centripetal force be weak enough, the lines AH and AI drawn from the centre A to the body at H and at I, shall be more obliquely inclined to the curve than the line AB is inclined towards BG. The centripetal force may be of such a strength as to render all these inclinations equal; or if stronger, the inclinations at I and K will be less oblique than at B; and Sir Isaac Newton has particularly shown, that if the centripetal power decreases after a certain manner without the increase of distance, a body may describe such a curve line, that all the lines drawn from the centre to the body shall be equally inclined to that curve line.

258 Revolution of a body round a centre explained.

We must farther remark, that if the centripetal power, while the body increases its distance from the centre, retain sufficient strength to make the lines drawn from the centre to the body to become at length less oblique to the curve; then, if this diminution of the obliquity continue, till at last the line drawn from the centre to the body shall cease to be obliquely inclined to the curve, and become perpendicular thereto; from this instant the body shall no longer recede from the centre, but in its following motion shall again descend, and describe a curve in all respects like that which it has described already, provided the centripetal power, every where at the same distance from the body, acts with the same strength. This return of the body may be proved by the following proposition: That if the body in any place, suppose at I, were to be stopped, and thrown directly backward with the velocity wherewith it was moving forward in that point I, then the body, by the action of the centripetal force upon it, would move back again over the path IHB, in which it had before advanced

vanced forward, and would arrive again at the point B in the same space of time as was taken up in its passage from B to I; the velocity of the body at its return from the point B being the same as that wherewith it first set out from that point.

The truth of this proposition may be illustrated in the following manner. Suppose, in fig. 110, that a body were carried after the following manner through the bent figure ABCDEF, composed of the straight lines AB, BC, CD, DE, EF, let the body then first be supposed to receive an impulse to some point within the concavity of the figure, as G. Now, as this body, when once moving in the straight line AB, will continue to move on in this line as long as it shall be left to itself; but being disturbed at the point B by the impulse given it, it will be turned out of this line AB into some other straight line, wherein it will afterwards continue to move as long as it shall be left to itself: therefore, let this impulse have strength sufficient to turn the body into the line BC; then let the body move on undisturbed from B to C: but at C let it receive another impulse pointed also towards G, and of sufficient strength to turn the body into the line CD; at D let a third impulse turn it into the line DE; and at E let another turn it into EF. Now, if the body, while moving on in the line EF, be stopped and turned back again with the same velocity with which it was moving forward, then by the repetition of the former impulse at E, the body will be turned in the line ED, and move in it from E to D with the same velocity as that wherewith it was moving forward in this line; then by a repetition of the impulse at D, when the body shall have returned to that point, it will be turned into the line DC; and by the repetition of the former impulses at C and at B, the body will be brought back again into the line BA, with the velocity wherewith it first moved in that line.

To illustrate this still further, let DE and FE be continued beyond E. In DE thus continued, take at pleasure the length EH, and let HI be so drawn as to be equidistant from the line GE; then, from the second law of motion, it follows, that after the impulse on the body on E, it will move through the space EI in the same time it would have employed in moving from E to H with the velocity it had in the line DE. In FE prolonged, take EK equal to EI, and draw KL equidistant from GE. Then because the body is thrown back in the line FE with the same velocity with which it went forward in that line, if, when the body was returned to E, it were permitted to go straight on, it would pass through EK in the same time as it took up in passing through EI, when it went forward in the line EF. But if, at the body's return to the point E, such an impulse directed toward the point D were to be given it as was sufficient to turn it into the line DE, it is plain that this impulse must be equal to that which originally turned the body out of the line DE into EF; and that the velocity with which the body will return into the line ED is the same as that wherewith it moved before through this line from D to E. Because EK is equal to EI, and KL and HI being each equidistant from GE, are by consequence equidistant from each other; it follows, that the two triangular figures IEH and KEL are altogether like and equal to each other. EK therefore being equal to EI, and EL equal to KH, and KL equal to HL, it is plain, that the body, after its return to E, being turned out of the line FE into ED by an impulse acting upon it in E after the manner abovementioned, it will receive such a velocity by this impulse as will carry it through EL in the same time it would have taken to go through EK, if it had passed through it undisturbed. It has already been observed, that the time in which the body would pass over EK, with the velocity wherewith it returns, is equal to the time it took up in going forward from E to I; that is, to the time in which it would have gone through EH with the velocity wherewith it moved from D to E: therefore the time in which the body will pass from E to L, after its return into the line ED, is the same as would have been taken up by the body in passing through the line EH with the velocity wherewith it first moved in the line DE. Since, therefore EL and EH are equal, the body returns into the line DE with the velocity which it had before in that line.—Again, we may affirm, that the second impulse in E is equal to the first; for as the impulse in E, whereby the body was turned out of the line DE into the line EF, is of such strength, that if the body had been at rest when this impulse had acted upon it, it would have communicated as much motion to it as would have been sufficient to carry it through a length equal to HI, in the time wherein the body would have passed from E to H, or in the time wherein it passed from E to I. In the same manner on the return of the body, the impulse in E, whereby it is turned out of the line FE into ED, is of such strength, that if it had acted on the body at rest, it would have caused it move through a length equal to KL in the same time as the body would employ in passing through EK with the velocity wherewith it returns in the line FE: therefore the second impulse, had it acted on the body at rest, would have caused it to move through a length equal to KL in the same space of time as would have been taken up by the body in passing through a length equal to HI were the first impuse to act on the body while at rest. That is, the effects of the first and second impuse on the body when at rest would be the same: for KL and HI are equal; consequently the second impuse is equal to the first. Thus, if the body be returned through FE with the velocity wherewith it moved forward, it has been shown how, by the repetition of the impulse which acted on it in E, the body will return again into the line DE with the velocity which it had before in that line. By the same method of reasoning it may be proved, that when the body is returned back to D, the impulse which before acted on that point will throw the body into the line DC with the velocity which it first had in that line; and the other impulses being successively repeated, the body will at length be brought back again into the line BA with the velocity wherewith it set out in that line.—Thus these impulses, by acting over again in an inverted order all their operations on the body, bring it back again through the path in which it had proceeded forward; and this obtains equally whatever be the number of straight lines whereof this curve figure is composed. Now, by a method of reasoning of which Sir Isaac Newton made much use, and which he introduced into geometry.

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metry, thereby greatly enriching that science, we might make a transition from this figure, composed of a number straight lines, to a figure of one continued curvature, and from a number of separate impulses repeated at distinct intervals to a continued centripetal force, and show, that because what has been here advanced holds universally true whatever be the number of straight lines whereof the curve figure ACF is composed, and however frequently the impulses at the angles of this figure are repeated; therefore the same will still remain true although this figure should be converted into one of a continued curvature; and these distinct impulses should be changed into a continual centripetal force.

This being allowed, suppose the body in K to have the line AK no longer obliquely inclined to its motion. In this case, if the body be turned back in the manner we have been considering, it must be directed back perpendicularly to AK; but if it had proceeded forward, it would likewise have moved in a direction perpendicular to AK: consequently, whether it move from this point K backward or forward, it must describe the same kind of course. Therefore, since by being turned back it will go over again the line KIHB, if it be permitted to go forward, the line KL, which it shall describe, will be altogether similar to the line KHB.

In like manner we may determine the nature of the motion, if the line wherein the body sets out be inclined, as in fig. 111. down toward the line BA drawn between the body and the centre. If the centripetal power so much increases in strength as the body approaches, that it can bend the path in which the body moves to that degree as to cause all the lines, AH, AI, AK, to remain no less oblique to the motion of the body than AB is oblique to BC, the body shall continually more and more approach the centre: But if the centripetal power increases in so much less a degree as to permit the line drawn from the centre to the body, as it accompanies the body in its motion, at length to become more and more erect to the curve wherein the body moves, and in the end, suppose at K, to become perpendicular to it; from that time the body shall rise again. This is evident from what has been said above; because, for the very same reason, here also the body will proceed from the point K to describe a line altogether similar to that in which it has moved from B to K. Thus it happens as in the pendulum, which, all the time it approaches a perpendicular position towards the horizon, descends more and more; but as soon as it is come into that situation, it immediately rises again by the same degrees as it descended before: so here the body more and more approaches the centre all the time it is moving from B to K; but thenceforward it rises from the centre again by the same degrees as it approached before.

If, as in fig. 112. the line BC be perpendicular to AB; then as has already been observed, the centripetal power may be so balanced with the progressive motion of the body, that it may keep moving round the centre A constantly at the same distance, as the body does when whirled about any point to which it is tied by a string. If the centripetal power be too weak to produce this effect, the motion of the body will presently become oblique to the line drawn from itself to the centre; but if it be stronger, the body must constantly keep moving in a curve to which a line drawn from it to the body is perpendicular.

If the centripetal power change with the change of distance, in such a manner that the body, after its motion has become oblique to the line drawn from itself to the centre, shall again become perpendicular thereto; then the body shall, in its subsequent motion, return again to the distance of AB, and from that distance take a course similar to the former: and thus, if the body move in a space void of all resistance, which has been all along supposed, it will continue in a perpetual motion about the centre, descending and ascending from it alternately. If the body, setting out from B (fig. 113.) in the line BC perpendicular to AB, describe the line BDE, which in D shall be oblique to the line AD; but in E shall again become erect to AE, drawn from the body in E to the centre A; then from this point E the body shall describe the line EFG entirely similar to BDE, and at G shall be at the same distance as it was at B; and the line AG shall be erect to the body's motion. Therefore the body shall proceed to describe from G the line GHI altogether similar to the line GFE, and at I it will have the same distance from the centre as it had at E; and also have the line AI erect to its motion: so that its subsequent motion must be in the line IKL similar to IKG, and the distance AL equal to AG. Thus the body will go on in a perpetual round without ceasing, alternately enlarging and contracting its distance from the centre.

If it so happen that the point E fall upon the line BA, continued beyond A; then the point G will fall upon B, I on E, and L also on B; so that the body will in this case describe a simple curve line round the centre A, like the line BDEF in fig. 114. in which it will revolve from B to E, and from E to B, without end. If AE in fig. 113. should happen to be perpendicular to AB, in this case also a simple line will be described; for the point G will fall on the line BA prolonged beyond A; the point I on the line AE prolonged beyond A, and the point L on B; so that the body will describe a line like the curve line BEGI in fig. 115. in which the opposite points B and G are equally distant from A; and the opposite points E and L are also equally distant from the same point A. In other cases the body will have a course of a more complicated nature.

Thus it must be apparent how a body, while it is constantly attracted towards a centre, may notwithstanding by its progressive motion keep itself from falling down to the centre, describing about it an endless circuit, sometimes approaching and sometimes receding from it. Hitherto, however, we have supposed, that the centripetal power is every where of equal strength at the same distance from the centre: and this is indeed the case with that power which keeps the planets in their orbits; but a body may be kept on in a perpetual circuit round the centre, although the centripetal power be kept moving in any curve line whatever, that shall have its concavity turned every where towards the centre of the force. To illustrate this, we shall in the first place propose the case of a body moving the incurvated figure ABCDE (fig. 116.), which is composed of the straight lines AB, BC, CD, DE,

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and EA; the motion being carried on in the following manner. Let the body first move in the line AB with any uniform velocity. When it is arrived at the point B, let it receive an impulse directed towards any point F taken within the figure; and let the impulse be of such a strength as to turn the body out of the line AB into the line BC: The body after this impulse, while left to itself, will continue moving in the line BC. At C let the body receive another impulse directed towards the same point F, of such a strength as to turn it from the line BC into CD. At D, let the body, by another impulse, directed likewise to the point F, be turned out of the line CD into DE. At E let another impulse, directed likewise toward the point F, turn the body from the line DE into AE: and thus the body will, by means of these impulses, be carried thro' the whole figure ABCDE.

Again, when the body is come to the point A, if it there receive another impulse directed like the rest to the point F, and of such a degree of strength as to turn it into the line AB, wherein it first moved; the body will then return into this line with the same velocity it had originally. To understand this, let AB be prolonged beyond B at pleasure, suppose to G; and from G let GH be drawn; which, if produced, should always continue equidistant from BF, i. e. let GH be drawn parallel to BF, in the time, then, in which the body would have moved from B to G, had it not received a new impulse in B; by the means of that impulse it will have acquired a velocity which will carry it from B to H. After the same manner, if CI be taken equal to BH, and IK be drawn parallel to CF, the body will have moved from C to K, with the velocity which it has in the line CD, in the same time it would have employed in moving from C to I with the velocity it had in the line BC. Therefore, since CI and BH are equal, the body will move through CK in the same time as it would have taken up in moving from B to G with the velocity wherewith it moved through the line AB. Again, DL being taken equal to CK, and LM drawn parallel to DF, the body will, for the same reason as before, move through DM with the velocity which it has in the line DE, in the same time it would employ in moving through BG with its original velocity. Lastly, if EN be taken equal to DM, and NO be drawn parallel to EF; likewise, if AP be taken equal to EO, and PQ be drawn parallel to AF; then the body, with the velocity wherewith it returns into the line AB, will pass thro' AQ in the time it would have employed in passing through BG with its original velocity. Now as all this follows directly from what has been delivered concerning oblique impulses impressed upon bodies in motion; so we must here observe farther, that it can be proved by geometry, that AQ will always be equal to BG; which being granted, it follows, that the body has returned into the line AB with the same velocity which it had when it first moved in that line; for the velocity with which it returns into the line AB, will carry it over the line AQ in the same time as would have been taken up in its passing over an equal line BG with the original velocity.

The conclusion naturally deduced from the above reasoning is, that by means of a centripetal and projectile force, a body may be carried round any fixed point in a curve figure which shall be concave towards it, as that marked ABC, fig. 117. and when it is returned to that point from whence it set out, it shall recover again the velocity with which it departed from that point. It is not indeed always necessary that it should return again into its first course, for the curve line may have some such figure as ABCDBE in fig. 118. In this curve line, if the body set out from B in the direction BF, and moved through the line BCD till it returned to B; here the body would not enter again into the line BCD, because the two parts BD and BC of the curve line make an angle at the point B: so that the centripetal power, which at the point B would turn the body from the line BF into the curve, will not be able to turn it into the line BC from the direction in which it returns to the point B. A forcible impulse must be given the body in the point B to produce that effect. If, at the point B, whence the body sets out, the curve line return into itself, as in fig. 117. then the body, upon its arrival again at B, may return into its former course, and thus make an endless circuit about the centre.

259 A body may be moved in any curvilinear direction by means of centripetal force.

260 Calculation of the force requisite to carry a body in any curve line.

The force requisite to carry a body in any curve line proposed, is to be deduced from the curvature which the figure has in any part of it. Sir Isaac Newton has laid down the following proposition as a foundation for discovering this, viz. that if a line be drawn from some fixed point to the body, and remaining by one extreme united to that point, it be carried round along with the body; then if the power whereby the body is kept in its course be always pointed to this fixed point as a centre, this line will move over equal spaces in equal portions of time. Suppose a body were moving through the curve line ABCD (fig. 120), and passed over the arches AB, BC, CD in equal portions of time; then if a point, as E, can be found, from whence the line EA being drawn to the body in accompanying it in its motion, it shall make the spaces EAB, EBC, and ECD, over which it passes, equal where the times are equal; then is the body kept in this line by a power always pointed to E as a centre. To prove this, suppose a body set out from the point A, fig. 121. to move in the straight line AB; and after it had moved for some time in that line, it were to receive an impulse directed to some point, as C. Let it receive that impulse at D, and thereby be turned into the line DE; and let the body, after this impulse, take the same time in passing from D to E that is employed in passing from A to D. Then the straight lines CA, CD, and CE being drawn, the triangular spaces CAD and CDE are proved to be equal in the following manner. Let EF be drawn parallel to CD. Then, it follows, from the second law of motion, that since the body was moving in the line AB when it received the impulse in the direction DC, it will have moved after the impulse through the line DE in the same time as it would have moved through DF, provided it had received no disturbance in D. But the time of the body's moving from D to E is supposed to be equal to the time of its moving through AD; therefore the time which the body would have employed in moving through DF, had it not been disturbed in D, is equal to the time wherein it moved through AD; consequently DF is equal in length to AD; for if the body had gone on to move through the line AB without inter-

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interruption, it would have moved through all the parts of it with the same velocity, and have passed over equal parts of that line in equal portions of time. Now CF being drawn, since AD and DF are equal, the triangular space CDF is equal to the triangular space CAD. Farther, the line EF being parallel to CD, it follows from the 37th proposition of Euclid's first book, that the triangle CED is equal to the triangle CFD: therefore the triangle CED is equal to the triangle CAD.

In like manner, if the body receive at E another impulse directed toward the point C, and be turned by that impulse into the line EG; if it move afterwards from E to G in the same space of time as was taken up by its motion from D to E, or from A to D; then CG being drawn, the triangle CEG is equal to CDE. A third impulse at G, directed as the two former to C, whereby the body shall be turned into the line GH, will have also the like effect with the rest. If the body move over GH in the same time as it took up in moving over EG, the triangle CGH will be equal to the triangle CEG. Lastly, if the body at H be turned by a fresh impulse directed toward C into the line HI, and at I by another impulse directed also to C be turned into the line IK; and if the body move over each of the lines HI and IK in the same time as it employed in moving over each of the preceding lines AD, DE, EG, and GH: then each of the triangles CHI and CIK will be equal to each of the preceding. Likewise, as the time in which the body moves over ADE is equal to the time of its moving over EGH, and to the time of its moving over HIK; the space CADE will be equal to the space CEGH and to the space CHIK. In the same manner, as the time in which the body moved over ADEG is equal to the time of its moving over GHIK, so the space CADEG will be equal to the space CGHIK. From this principle Sir Isaac Newton demonstrates the above-mentioned proposition, by making the transition from this incurvated figure composed of straight lines, to a figure of continued curvation; and by showing, that since equal spaces are described in equal times, in this present figure composed of straight lines, the same relation between the spaces described and the times of their description will also have place in a figure of one continued curvature. He also deduces from this proposition the reverse of it; and proves, that whenever equal spaces are continually described, the body is acted upon by a centripetal force directed to the centre at which the spaces terminate.

Having thus endeavoured to illustrate the fundamental principle of the Newtonian philosophy, at least as far as it regards the motion of the planets and heavenly bodies, we shall now proceed to the more particular application of it. The first thing undertaken by Sir Isaac in order to explain those motions, is to demonstrate, that in the celestial spaces there is no sensible matter. That the heavenly bodies suffer no sensible resistance from any matter of this kind, is evident from the agreement betwixt astronomical observations in all ages with regard to the time in which the planets have been found to perform their revolutions. Des Cartes, however, was of opinion, that the planets might be kept in their courses by means of a fluid matter,

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No sensible matter in the celestial spaces.

which continually circulating round, should carry the planets along with it; and there is one appearance which seems to favour this opinion, viz. that the sun turns round his axis the same way the planets move; the earth also turns round its axis the same way as the moon turns round the earth, and the planet Jupiter turns round his axis the same way that his satellites revolve round him. It might therefore be supposed, that if the whole planetary region were filled with a fluid matter, the sun, by turning round on his own axis, might communicate motion first to that part of the fluid which was contiguous, and by degrees propagate the like motion to the parts more remote. After the same manner the earth might communicate motion to this fluid to a degree sufficient to carry round the moon; and Jupiter might communicate the like to the distance of its satellites. This system has been particularly examined by Sir Isaac Newton; who finds, that the velocities with which the parts of this fluid should move in different distances from the centre of motion will not agree with the motions observed in the different planets; for instance, that the time of one entire circulation of the fluid wherein Jupiter should swim, would bear a greater proportion to the time of one entire circulation of the fluid where the earth is, than the period of Jupiter bears to that of the earth. He proves also, that the planet cannot circulate in such a fluid, so as to keep long in the same course, unless the planet and the contiguous fluid are of the same density, and the planet be carried along with the same velocity as the fluid. There is also another remark made on this motion by Sir Isaac, viz. that some vivifying force will be continually necessary at the centre of the motion. The sun, in particular, by communicating motion to the ambient fluid, will lose from itself as much motion as it communicates to the fluid, unless some acting principle reside in the sun to renew its motion continually. If the fluid were infinite, this gradual loss of motion would continue till the whole should stop; and if the fluid were limited, this loss of motion would continue till there would remain no swifter a revolution in the sun than in the outermost part of the fluid, so that the whole would turn together about the axis of the sun like one solid globe. We must likewise observe, that as the planets do not move in perfect circles round the sun, there is a greater distance between their orbits in some places than others. For instance, the distance between the orbit of Mars and Venus is near half as great again in some part of their course as in others. Now here the fluid in which the earth should swim, must move with a less rapid motion where there is this greater interval between the contiguous orbits; but, on the contrary, where the space is straitest, the earth moves more slowly than where it is widest.

Again, if our globe of earth swam in a fluid of equal density with the earth itself, that is, in a fluid more dense than water, all bodies put in motion here upon the earth's surface must suffer a great resistance by it; whereas Sir Isaac Newton has made it evident, by experiments, that bodies, falling perpendicularly through the air, suffer only about one hundred and sixtieth part of the resistance from it that they meet with in water.

These

Motions of the Primary Planets.

These expetiments are applied by Sir Isaac yet farther to the general question concerning the absolute plenitude of space. He objects against the filling of all space with a subtile fluid, after the manner of Des Cartes, That all bodies must be immeasurably resisted by it. And lest it should be thought that this objection might be evaded by ascribing to this fluid such very minute and smooth parts as might remove all adhesion or friction between them, whereby all resistance would be lost, Sir Isaac proves, that fluids must resist from the inactivity of their particles, and that water and the air resist almost entirely on this account; so that in this subtile fluid, however smooth and lubricated the particles might be, yet if the whole were as dense as water, it would resist very near as much as water does: And whereas such a fluid, whose parts are absolutely close together without any intervening spaces, must be a great deal more dense than water, it must also resist more in proportion to its density, unless we suppose the matter of which this fluid is composed not to be endowed with the same degree of inactivity with other matter: But if you deprive any substance of the property so universally belonging to all other matter, without impropriety of speech it can scarce be called by this name. Sir Isaac also made an experiment to try in particular, whether the internal parts of bodies suffered any resistance; and the result did indeed appear to favour some small degree of resistance, but so very little as to leave it doubtful whether the effect did not arise from some other latent cause.

262 Objections to a pleuum.

§ 2. *Of the Motions of the Primary Planets.*

163 Planetry motions particularly explained.

Since the planets thus move in a space void of all resistance, they would, if once set in motion, continue to move on for ever on a straight line. We have, however, already observed, that the primary planets move about the sun in such a manner that a line extended from the sun to the planet would describe equal spaces in equal times; and this single property in the planetary motions proves, that they are continually acted upon by a power directed towards the sun as the centre. It has also been observed, that if the strength of the centripetal power were suitably accommodated every where to the motion of any body round a centre, the body might be carried in any bent line whatever, whose concavity should be every where turned towards the centre of that force; and likewise that the strength of the centripetal force in each place was to he collected from the nature of the line wherein the body moved. Now since each of the planets moves in an ellipsis, having the sun in one of its foci, Sir Isaac Newton demonstrates, that the strength of this power is reciprocally in the duplicate proportion of the distance from the sun. This proportion may be explained in the following manner: Suppose several distances to bear to each other the proportions of the numbers 1, 2, 3, 4, 5; that is, let the second distance be double the first, the third three times, the fourth four times, and the fifth five times as great as the first; multiply each of these numbers by itself, and 1 multiplied by 1 produces still 1, 2 multiplied by 2 produces 4, 3 by 3 produces 9, 4 by 4 produces 16, and 5 by 5 produces 25; this being done, the fractions $\frac{1}{4}$, $\frac{1}{9}$, $\frac{1}{16}$, and $\frac{1}{25}$, will respectively express the proportion which the centripetal power in each of the following distances bears to the power at the first distance: for in the second distance, which is double the first, the centripetal power will be one-fourth part only of the power at the first distance; at the third distance, the power will only be one-ninth part of the first power; at the fourth distance, the power will be only one-sixteenth; and at the fifth distance only one twenty-fifth, of the first power. Thus is found the proportion in which the centripetal power decreases, as the distance from the sun increases within the compass of one planet's motion. How it comes to pass that the planet can be carried about the sun by this centripetal power in a continual round, sometimes rising from the sun, then descending again as low, appears from what has been already said concerning centripetal forces.

264 Reciprocal duplicate proportion explained.

265 Centripetal power proved to extend throughout the system.

In order to know whether this centripetal power extends in the same proportion throughout the system, and consequently whether all the planets are influenced by it, Sir Isaac inquires what relation there ought to be between the periods of the different planets, provided they were acted upon by the same power, decreasing throughout in the proportion abovementioned; and he finds, that the period of each, in this case, would have that very proportion to the greater axis of its orbit which has been already related: which puts it beyond a doubt, that the different planets are pressed towards the sun in the same proportion to the distances as one planet is in its several distances; whence it is justly concluded, that there is such a power acting towards the sun in the foresaid proportion at all distances from it. This power, when refered to the earth, Sir Isaac calls *gravity*; when to the sun, *attraction*; and to the planets, *centripetal* force. By these means, however, he designs only to signify a power endowed with the properties abovementioned; but by no means would have it understood as if these names referred any way to the cause of it.

266 Centripetal power defined.

View of Sir Isaac Newton's Philosophy, p. 175.

267 Minute variations in the planetary motions accounted for.

" But now (says Mr Pemberton) in these demonstrations, some very minute inequalities in the motion of the planets are neglected; which is done with a great deal of judgment: for whatever be their cause, the effects are very inconsiderable, they being so exceedingly small, that some astronomers have thought fit wholly to pass them by. However, the excellency of this philosophy, when in the hands of so great a geometer as our author (Sir Isaac Newton), is such, that it is able to trace the least variations of things up to their causes. The only inequalities which have been observed common to all the planets are, the motion of the aphelion and the nodes. The transverse axis of each orbit does not remain always fixed, but moves about the sun with a very slow progressive motion; nor do the planets keep constantly in the same planes, but changes them and the lines by which these planes intersect each other by insensible degrees. The first of these inequalities, which is the motion of the aphelion, may be accounted for, by supposing the gravitation of the planets towards the sun to differ a little farther from the forementioned reciprocal duplicate proportion of the distances: but the second, which is the motion of the nodes, cannot be accounted for by any power directed towards the sun; for no such power can give it any lateral impulse to divert it from the plane of its motion into any new plane, but of necessity must be derived from some other centre. Where

268 Motion of the aphelion accounted for.

that

Motions of the Primary Planets.

that power is lodged, remains to be discovered. Now it is proved, as shall be afterwards explained, that the three primary planets, Saturn, Jupiter, and the Earth, which have satellites revolving about them, are endowed with a power of causing bodies, in particular those satellites, to gravitate towards them with a force which is reciprocally in the duplicate proportion of their distances; and the planets are, in all respects in which they come under our consideration, so similar and alike, that there is no reason to question but that they have all the same property, though it be sufficient for the present purpose to have it proved of Jupiter and Saturn only; for these planets contain much greater quantities of matter than the rest, and proportionally exceed the others in power. But the influence of these two planets being allowed, it is evident how the planets come to shift their places continually: for each of the planets moving in a different plane, the action of Jupiter and Saturn upon the rest will be oblique to the planes of their motion, and therefore will gradually draw them into new ones. The same action of these two planets upon the rest will likewise cause a progressive motion; and therefore will gradually draw them into new ones. The same action of these two planets upon the rest will likewise cause a progressive motion of the aphelion; so that there will be no necessity for having recourse to the other cause for this motion, which was before hinted at, viz, the gravitation of the planets towards the sun differing from the exact duplicate proportion of their distances. And in the last place, the action of Jupiter and Saturn upon each other will produce in their motions the same inequalities as their joint action produces upon the rest. All this is effected in the same manner as the sun produces the same kind of inequalities and many others in the motion of the moon and other secondary planets; and therefore will be best apprehended by what is said afterwards. Those other irregularities in the motion of the secondary planets have place likewise here, but are too minute to be observable, because they are produced and rectified alternately, for the most part in the time of a single revolution; whereas the motion of the aphelion and nodes which increase continually, become sensible after a long series of years.

269 Jupiter and Saturn influence eachother's motions.

Yet some of these other inequalities are discernible in Jupiter and Saturn; in Saturn chiefly: for when Jupiter, who moves faster than Saturn, approaches to a conjunction with him, his action upon the latter will a little retard the motion of that planet; and by the reciprocal action of Saturn, he will himself be accelerated. After conjunction, Jupiter will again accelerate Saturn, and be likewise retarded in the same degree as before the first was retarded and the latter accelerated. Whatever inequalities besides are produced in the motion of Saturn by the action of Jupiter upon that planet, will be sufficiently rectified by placing the focus of Saturn's ellipsis, which should otherwise be in the sun, in the common centre of gravity of the sun and Jupiter. And all the inequalities of Jupiter's motions, caused by the action of Saturn upon him, are much less considerable than the irregularities of Saturn's motion. This one principle therefore of the planets having a power as well as the sun to cause bodies gravitate towards them, which is proved by the motion of the secondary planets to obtain in fact, explains all the irregularities relating to the planetary motions ever observed by astronomers (A).

270 Method of correcting the planetary motions.

"Sir Isaac Newton after this proceeds to make an improvement in astronomy, by applying this theory to the farther correction of their motions. For as we have here observed the planets to possess a principle of gravitation as well as the sun; so it will be explained at large hereafter, that the third law of motion, which makes action and reaction equal, is to be applied in this case, and that the sun does not only attract each planet, but is also itself attracted by them; the force wherewith the planet is acted on bearing to the force wherewith the sun itself is acted upon at the same time, the proportion which the quantity of matter in the sun bears to the quantity of matter in the planet.

271 Sun moves round the common centre of gravity of him and the planets.

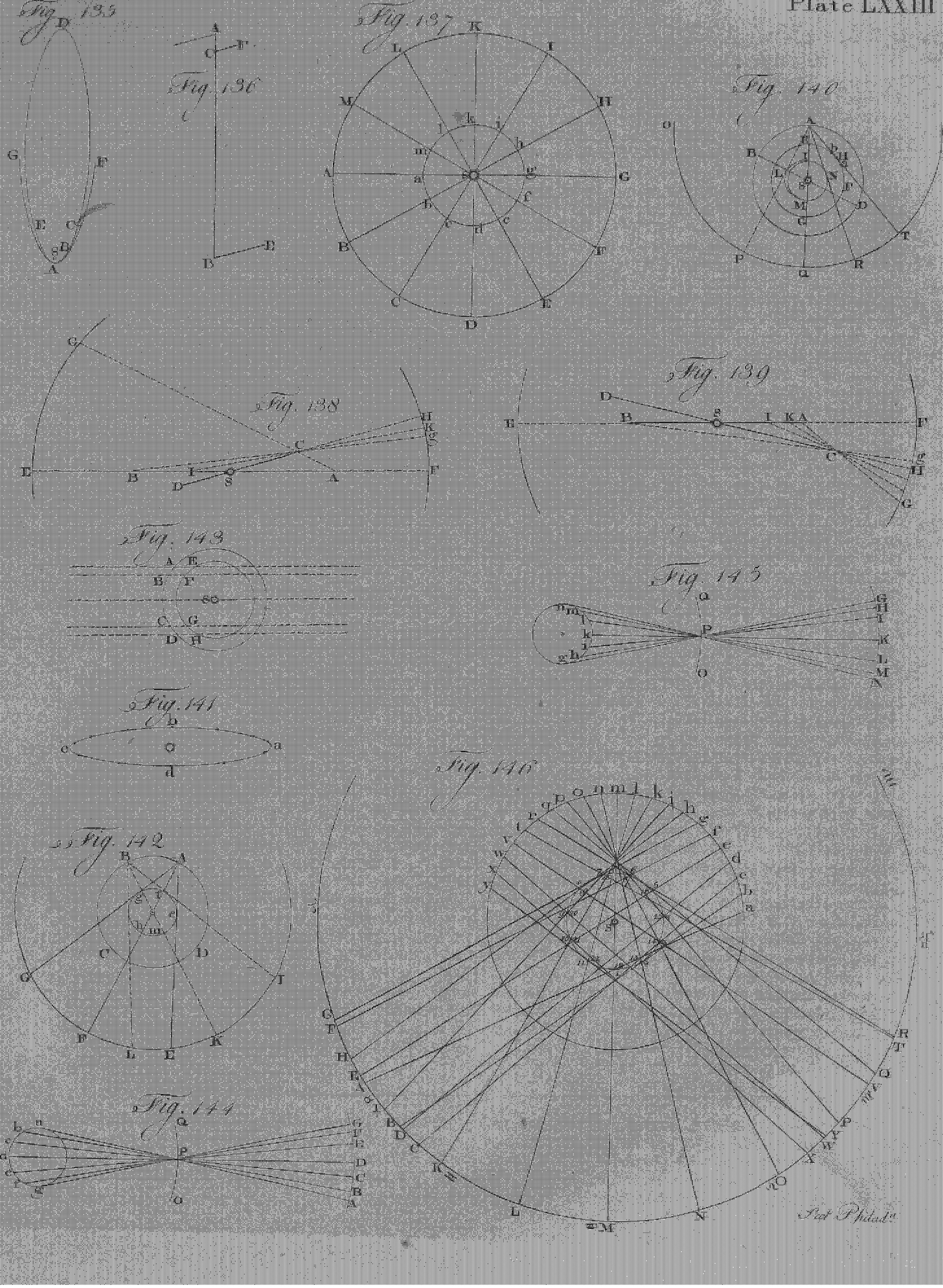
From the action of the sun and planet being thus mutual, Sir Isaac Newton proves that the sun and planet will describe about their common centre of gravity similar ellipses; and then, that the transverse axis of the ellipses, which would be described about the sun at rest in the same time, the same proportion as the quantity of solid matter in the sun and planet together bears to the first of two mean proportionals between this quantity and the quantity of matter in the sun only.

"It will be asked, perhaps, how this correction can be admitted, when the cause of the motions of the planets was before found, by supposing them to be the centre of the power which acted upon them? for, according to the present correction, this power appears rather to be directed to the common centre of gravity. But whereas the sun was at first concluded to be the centre to which the power acting on the planets was directed, because the spaces described in equal times round the sun were found to be equal; so Sir Isaac Newton proves, that if the sun and planet move round their common centre of gravity, yet, to an eye placed in the planet, the spaces which will appear to be described about the sun will have the same relation to the times of their description as the real spaces would if the sun were at rest. I further asserted, that, supposing the planets to move round the sun at rest, and to be attracted by a power which should every where act with degrees of strength reciprocally in the duplicate proportions of their distances; then the periods of the planets must observe the same relations to their distances as astronomers have found them to do. But here it must not be supposed, that the observations of astronomers absolutely agree without any the least difference: and the present correction will not cause a deviation

(A) Professor J. Robison, however, informs us in his paper on the *Georgium Sidus* (Edinburgh Philosophical Transactions, Vol. I.), That *all* the irregularities in the planetary motions *cannot* be accounted for from the laws of gravitation; for which reason he was obliged to suppose the existence of planets beyond the orbit of Saturn, even before the discovery of the *Georgium Sidus*. M. de la Lande also has observed some unaccountable inequalities in the motion of Saturn for more than 30 years past.

ASTRONOMY

Plate LXXIII



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deviation from any one astronomer's observations so much as they differ from one another; for in Jupiter, where this correction is greatest, it hardly amounts to the 3000th part of the whole axis.

272 Argument against the eternity of the world.

"Upon this head, I think it not improper to mention a reflection made by our excellent author upon these small inequalities in the planets motions, which contains in it a very strong philosophical argument against the eternity of the world. It is this, that these inequalities must continually increase by slow degrees, till they render at length the present frame of nature unfit for the purposes it now serves. And a more convincing proof cannot be desired against the present constitution's having existed from eternity than this, that a certain period of years will bring it to an end. I am aware, that this thought of our author has been represented even as impious, and as no less than casting a reflection upon the wisdom of the Author of nature for framing a perishable work. But I think so bold an assertion ought to have been made with singular caution: for if this remark upon the increasing irregularies in the heavenly motions be true in fact, as it really is, the imputation must return upon the assertor, that this does not detract from the divine wisdom. Certainly we cannot pretend to know all the omniscient Creator's purposes in making this world, and therefor cannot pretend to determine how long he designed it should last; and it is sufficient if it endure the time designed by the Author. The body of every animal shows the unlimited wisdom of the Author no less, nay, in many respects more, than the larger frame of nature; and yet we see they are all designed to last but a small space of time.

§ 3. *The Motions of the Secondary Planets explained from the Principles laid down in* § 1.

The excellency of the Newtonian philosophy is discoverable even more in its solution of the motions of the secondary than in those of the primary planets; for thus not only all the irregularities formerly discovered by astronomers in these motions are solved in a satisfactory manner, but several others are discovered of such a complicated nature that they could never be distinguished into proper heads. These, however, are now not only found out from their causes, which this philosophy has brought to light; but the dependence of them upon their causes is also shown in such a perfect manner, that the degree of them may be exactly computed. Thus Sir Isaac Newton found means to compute the moon's motion so exactly, that he framed a theory from which the place of that planet may at all times be computed very nearly, or altogether, as exactly as the places of the primary planets themselves; which is much beyond what the greatest astronomers could ever effect.

273 Secondaries attracted by their primaries.

The first thing demonstrated of these secondary planets is, that they are drawn towards their respective primaries in the same manner as the latter are attracted by the sun. That each secondary planet is kept in its orbit by a power directed towards its primary, &c. is proved from the phenomenon of the satellites of Jupiter and Saturn; because they move in circles, as far as we can observe, about their respective primaries with an equable course, the primary being the centre of each orbit: and by comparing the times in which the different satellites of the same primary perform their periods, they are found to observe the same relation to the distances from their primary as the primary planets observe in respect of their mean distances from the sun. The same thing holds good also with regard to the earth and moon: for she is found to move round the earth in an ellipsis after the same manner as the primary planets do about the sun, excepting only some small irregularities in her motions, the cause of which will be particularly explained in what follows; whereby it will appear that they are no objections against the earth's acting on the moon in the same manner as the sun acts on the primary planets; that is, as Jupiter and Saturn act upon their satellites.

274 Power of Jupiter and Saturn discovered by their satellites.

By the number of satellites which move round Jupiter and Saturn, the power of each of these planets may be measured to a very considerable distance; for the distance of the outermost satellite in each of these planets exceeds several times the distance of the innermost. The force of the earth upon the moon, however, at different distances, is more confirmed by the following consideration than any analogical reasoning.

275 Gravity retains the moon in her orbit.

It will appear, that if the power of the earth by which it retains the moon in her orbit be supposed to act at all distances between the earth and moon, according to the rule already mentioned, this power will be sufficient to produce upon bodies near the surface of the earth all the effects ascribed to the principle of gravity. This is discovered by the following method. Let A (in fig. 122.) represent the earth, B the moon, BCD the moon's orbit; which differs little from a circle of which A is the centre. If the moon in B were left to itself to move with the velocity it has in the point B, it would leave the orbit, and proceed straight forward in the line BE which touches the orbit in B. Suppose the moon would upon this condition move from

276 Her motion particularly explained.

B to E in the space of one minute of time. By the action of the earth upon the moon, whereby it is retained in its orbit, the moon will really be found at the end of this minute in the point F, from whence a stright line drawn to A shall make the space BFA in the circle equal to the triangular space BEA; so that the moon in the time wherein it would have moved from B to E, if left to itself, has been impelled towards the earth from E to F. And when the time of the moon's passing from B to F is small, as here it is only one minute, the distance between E and F scarce differs from the space through which the moon would descend in the same time if it were to fall directly down from B toward A without any other motion. AB, the distance of the moon from the earth, is about 60 of the semidiameters of the latter; and the moon completes her revolution round the earth in about 27 days 7 hours and 43 minutes; therefore the space EF will here be found by computation to be about $16\frac{1}{8}$ feet. Consequently, if the power by which the moon is retained in its orbit be near the surface of the earth greater than at the distance of the moon in the duplicate proportion of that distance, the number of feet a

277 Calculation of the velocity of falling bodies.

body would descend near the surface of the earth by the action of this power upon it, in one minute, would be equal to the number $16\frac{1}{8}$ multiplied twice into the number 60; that is, to 58050. But how fast bodies fall near the surface of the earth may be known by the pendulum; and by the exactest experiments, they

are

Motions of the Secondary Planets.

are found to descend the space of 16$\frac{1}{8}$ feet in one second; and the spaces described by falling bodies being in the duplicate proportion of the times of their fall, the number of feet a body would describe in its fall near the surface of the earth in one minute of time will be equal to 16$\frac{1}{8}$ twice multiplied by 60; the same as would be caused by the power which acts upon the moon.

278 Earth and moon move about their common centre of gravity.

In this computation the earth is supposed to be at rest: but it would have been more exact to have supposed it to move, as well as the moon, about their common centre of gravity; as will easily be understood from what has been already said concerning the motion of the sun and primary planets about their common centre of gravity. The action of the sun upon the moon is also here neglected; and Sir Isaac Newton shows, if you take in both these considerations, the present computation will best agree to a somewhat greater distance of the moon and earth, viz. to 61$\frac{1}{2}$ semidiameters of the latter, which distance is more conformable to astronomical observations; and these computations afford an additional proof that the action of the earth observes the same proportion to the distance which is here contended for. In Jupiter and Saturn this power is so far from being confined to a small extent of space, that it not only reaches to several satellites at very different distances, but also from one planet to another, nay, even through the whole planetary system; consequently there is no appearance of reason why this power should not act at all distances, even at the very surfaces of these planets as well as farther off. But from hence it follows, that the power which retains the moon in her orbit is the same as that which causes bodies near the surface of the earth to gravitate: for since the power by which the earth acts on the moon will cause bodies near the surface of it to descend with all the velocity they are found to do, it is certain no other power can act upon them besides; because if it did, they must of necessity descend swifter. Now, from all this, it is at length very evident, that the power in the earth which we call *gravity* extends up to the moon, and decreases in the duplicate proportion of the increase of the distance from the earth.

279 Action of the sun upon the secondary Planets.

Thus far with respect to the action of the primary planets upon their secondaries. The next thing to be shown is, that the sun likewise acts upon them. For this purpose we must observe, that if to the motion of the satellite whereby it would be carried round its primary at rest, we superadd the same motion, both in regard to the velocity and direction, as the primary itself has, it will describe about the primary the same orbit with as great regularity as if the primary had been indeed at rest. This proceeds from the law of motion, which makes a body near the surface of the earth descend perpendicularly, though the earth be in so swift a motion, that if the falling body did not partake of it, its descent would be remarkably oblique; and that a body projected describes in the most regular manner the same parabola, whether projected in the direction in which the earth moves, or in the opposite direction, if the projecting force be the same. From this we learn, that if the satellite moved about its primary with perfect regularity, besides its motion about the primary it would have the same progressive velocity with which the primary is carried about the sun, in a direction parallel to that impulse of its primary: And, on the contrary, the want of either of these, in particular of the impulse towards the sun, will occasion great inequalities in the motion of the secondary planet. The inequalities which would arise from the absence of this impulse towards the sun are so great, that by the regularity which appears in the motion of the secondary planets, it is proved, that the sun communicates to them the same velocity by its action as it gives to their primary at the same distance. For Sir Isaac Newton informs us, that upon examination he found, that if any of the satellites of Jupiter were attracted by the sun more or less than Jupiter himself at the same distance, the orbit of that satellite, instead of being concentrical to Jupiter, would have its centre at a greater or lesser distance than the centre of Jupiter from the sun, nearly in the subduplicate proportion of the difference between the sun's action upon the satellite and upon Jupiter. Therefore, if any satellite were attracted by the sun but one hundredth part more or less than Jupiter is at the same distance, the orbit of that satellite would be distant from the centre of Jupiter no less than a fifth part of the outermost satellite from Jupiter; which is almost the whole distance of the innermost satellite. By the like argument, the satellites of Saturn gravitate towards the sun as much as Saturn itself at the same distance, and the moon as much as the earth.

280 Secondary planets equally attracted by the sun with their primaries.

281 Whence the inequalities in the motions of the secondary planets arise.

Thus it is proved, that the sun acts upon the secondary planets as much as upon the primaries at the same distance: but it has also been shown, that the action of the sun upon bodies is reciprocally in the duplicate proportion of the distance; therefore the secondary planets being sometimes nearer to the sun than to the primary, and sometimes more remote, they are not always acted upon in the same degree with their primary, but when nearer to the sun are attracted more, and when further off are attracted less. Hence arise various inequalities in the motion of the secondary planets.

282 Inequalities of the moon's motion explained.

Some of these inequalities, however, would take place, though the moon if undisturbed by the sun had moved in a circle concentrical to the earth, and in the plane of the earth's motion; others depend on the elliptical figure and oblique situation of the moon's orbit. One of the former is, that the moon does not describe equal spaces in equal times, but is continually accelerated as she passes from the quarter to the new or full, and is retarded again by the like degrees in returning from the new and full to the next quarter: but here we consider not so much the absolute as the apparent motions of the moon with respect to us. These two may be distinguished in the following manner. Let S, in fig. 123. represent the sun, A the earth moving in its orbit BC, DEFG the moon's orbit, and H the place of the moon in her orbit. Suppose the earth to have moved from A to I. Because it has been shown that the moon partakes of all the progressive motion of the earth, and likewise that the sun attracts both the earth and moon equally when they are at the same distance from it, or that the mean action of the sun upon the moon is equal to its action upon the earth; we must therefore consider the moon as carrying about with it the moon's orbit: so that when the earth is removed from A to I, the moon's orbit shall likewise

be

be removed from its former situation into that denoted by KLMN. But now the earth being in I, if the moon were found in O, so that OI should be parallel to HA, though the moon would readily have moved from H to O, yet it would not have appeared to a spectator upon the earth to have moved at all, because the earth has moved as much as itself; so that the moon would still appear in the same place with respect to the fixed stars. But if the moon be observed in P, it will then appear to have moved, its apparent motion being measured by the angle under OIP. And if the angle under PIS be less than the angle under HAS, the moon will have approached nearer its conjunction with the sun. Now, to explain particularly the inequality of the moon's motion already mentioned, let S, in fig. 124. represent the sun, A the earth, BCDE the moon's orbit, C the place of the moon when in the latter quarter. Here it will be nearly at the same distance from the sun as the earth is. In this case, therefore, they will be both equally attracted, the earth in the direction AS, and the moon in that CS. Whence, as the earth, in moving round the sun, is continually descending towards it, so the moon in this situation must in any equal portion of time descend as much; and therefore the position of the line AC in respect of AS, and the change which the moon's motion produces in the angle CAS, will not be altered by the sun; but as soon as the moon is advanced from the quarter toward the new or conjunction, suppose to G, the action of the sun upon it will have a different effect. Were the sun's action upon the moon here to be applied in the direction GH parallel to AS, if its action on the moon were equal to its action on the earth, no change would be wrought by the sun on the apparent motion of the moon round the earth. But the moon receiving a greater impulse in G than the earth receives in A, were the sun to act in the direction GH, yet it would accelerate the description of the space DAG, and cause the angle under GAD to decrease faster than it otherwise would. The sun's action will have this effect upon account of the obliquity of its direction to that in which the earth attracts the moon. For the moon by this means is drawn by two forces oblique to one another; one drawing from G towards A, the other from G towards H; therefore the moon must necessarily be impelled toward D. Again, because the sun does not act in the direction GH parallel to SA, but in the direction GS oblique to it, the sun's action on the moon will, by reason of this obliquity, farther contribute to the moon's acceleration. Suppose the earth, in any short space of time, would have moved from A to I, if not attracted by the sun, the point I being in the straight line CE, which touches the earth's orbit in A. Suppose the moon in the same time would have moved in her orbit from G to K, and besides have partook of all the progressive motion of the earth. Then, if KL be drawn parallel to AI, and taken equal to it, the moon, if not attracted to the sun, would be found in L. But the earth, by the sun's action, is removed from I. Suppose it were moved down to M in the line IMN parallel to SA, and if the moon were attracted but as much, and in the same direction, as the earth is here supposed to be attracted, so as to have descended during the same time in the line LO parallel also to AS, down as far as P, till LP were equal to IM, the angle under PMN would be equal to that under LIN; that is, the moon will appear advanced as much farther forward than if neither it nor the earth had been subject to the sun's action. But this is on the supposition that the actions of the sun upon the earth and moon are equal; whereas the moon being acted upon more than the earth, did the sun's action draw the moon in the line LO parallel to AS, it would draw it down so far as to make LP greater than IM, whereby the angle under PMN will be rendered greater than that under LIN. But, moreover, as the sun draws the earth in a direction oblique to IN, the earth will be found in its orbit somewhat short of the point M. However, the moon is attracted by the sun still more out of the line LO than the earth is out of the line IN; therefore this obliquity of the sun's action will yet farther diminish the angle under PMN. Thus the moon at the point G receives an impulse from the sun whereby her motion is accelerated; and the sun producing this effect in every place between the quarter and the conjunction, the moon will move from the quarter with a motion continually more and more accelerated; and therefore, by acquiring from time to time an additional degree of velocity in its orbit, the spaces which are described in equal times by the line drawn from the earth to the moon will not be every where equal, but those toward the conjunction will be greater than those towards the quarter. But in the moon's passage from the conjunction D to the next quarter, the sun's action will again retard the moon, till, at the next quarter at E, it be restored to the first velocity which it had in C. When the moon moves from E to the full, or opposition to the sun in B, it is again accelerated; the deficiency of the sun's action on the moon from what it has upon the earth producing here the same effect as before the excess of its action.

Let us now consider the moon in Q as moving from E towards B. Here, if she were attracted by the sun in a direction parallel to AS, yet being acted on less than the earth, as the latter descends towards the sun, the moon will in some measure be left behind. Therefore, QF being drawn parallel to SB, a spectator on the earth would see the moon move as if attracted from the point Q in the direction QF, with a degree of force equal to that whereby the sun's action on the moon falls short of its action on the earth. But the obliquity of the sun's action has here also an effect. In the time the earth would have moved from A to I without the influence of the sun, let the moon have moved in its orbit from Q to R. Drawing, therefore, RT parallel and equal to AI, the moon, by the motion of its orbit, if not attracted by the sun, must be found in T; and therefore, if attracted in a direction parallel to SA, would be in the line TV parallel to AS; suppose in W. But the moon in Q being farther off the sun than the earth, it will be less attracted; that is, TW will be less than IM; and if the line SM be prolonged towards X, the angle under XMW will be less than XIT. Thus, by the sun's action, the moon's passage from the quarter to the full would be accelerated, if the sun were to act on the earth and moon in a direction parallel to AS: and the obliquity of the sun's action will still increase this acceleration: For

For the action of the sun on the moon is oblique to the line SA the whole time of the moon's passage from Q to T, and will carry her out of the line TV towards the earth. Here we suppose the time of the moon's passage from Q to T so short, that it shall not pass beyond the line SA. The earth will also come a little short of the line IN, as was already mentioned; and from these causes the angle under XMW will be still farther lessened. The moon, in passing from the opposition B to the next quarter, will be retarded again by the same degrees as it was accelerated before its appulse to the opposition; and thus the moon, by the sun's action upon it, is twice accelerated and twice restored to its first velocity every circuit it makes round the earth; and this inequality of the moon's motion about the earth is called by astronomers its variation.

283 Effect of the sun's attraction in different parts of the moon's orbit.

The next effect of the sun upon the moon is, that it gives the orbit of the latter in the quarters a greater degree of curvature than it would receive from the earth alone; and, on the contrary, in the conjunction and opposition the orbit is less inflected. When the moon is in the conjunction with the sun at D, the latter attracting her more forcibly than it does the earth, the moon is by that means impelled less to the earth than otherwise it would be, and thus the orbit less incurvated: for the power by which the moon is impelled towards the earth being that by which it is inflected from a rectilinear course, the less that power is the less it will be inflected. Again, when the moon is in the opposition in B farther removed from the sun than the earth is, it follows then, that though the earth and moon are both continually descending toward the sun, that is, are drawn by the sun towards itself out of the place they would otherwise move into, yet the moon descends with less velocity than the earth; insomuch that, in any given space of time from its passing the point of opposition, it will have less approached the earth than otherwise it would have done; that is, its orbit, in respect to the earth, will approach nearer to a straight line. Lastly, when the moon is in the quarter in F, and equally distant from the sun as the earth, it was before observed, that they would both descend with equal velocity towards the sun, so as to make no change in the angle FAS; but the length of the line FA must necessarily be shortened. Therefore the moon, in moving from F toward the conjunction with the sun, will be impelled more toward the earth by the sun's action than it would have been by the earth alone, if neither the earth nor the moon had been acted upon by the sun; so that, by this additional impulse, the orbit is rendered more curve than it otherwise should be. The same effect will also be produced in the other quarter.

A third effect of the sun's action, and which follows from that just now explained, is, that though the moon undisturbed by the sun might move in a circle, having the earth for its centre, by the sun's action, if the earth were to be in the very middle or centre of the moon's orbit, yet the moon would be nearer the

284 Moon comes nearest the earth when least attracted by it.

earth at the new and full than in the quarters. This may at first appear somewhat difficult to be understood, that the moon should come nearest to the earth where it is least attracted by it: yet, upon a little consideration, it will evidently appear to flow from that very cause, because her orbit, in the conjunction and opposition, is rendered less curve; for the less curve the orbit is, the less will the moon have descended from the place it would move into without the action of the earth. Now, if the moon were to move from any place without farther disturbance from that action, since it would proceed on the line touching the orbit in that place, it would continually recede from the earth; and therefore, if the power of the earth upon the moon be sufficient to retain it at the same distance, this diminution of that power will cause the distance to increase, though in a less degree. But, on the other hand, in the quarters, the moon being pressed in a less degree towards the earth than by the earth's single action, will be made to approach it: so that, in passing from the conjunction or opposition to the quarters, the moon ascends from the earth; and in passing from the quarters to the opposition or conjunction, it descends again, becoming nearer in these last mentioned places than in the other.

All the inequalities we have mentioned are different in degree as the sun is more or less distant from the earth; being greatest when the earth is in its perihelion, and smallest when it is in its aphelion: for in the quarters, the nearer the moon is to the sun the greater is the addition to the earth's action upon it by the power of the sun; and in the conjunction and opposition. the difference between the sun's action upon the earth and upon the moon is likewise so much the great-

285 Cause of the dilatation of the moon's orbit.

er. This difference in the distance between the earth and the sun produces a farther effect upon the moon's motion; causing her orbit to dilate when less remote from the sun, and become greater than when at a farther distance: For it is proved by Sir Isaac Newton, that the action of the sun by which it diminishes the earth's power over the moon in the conjunction or opposition, is about twice as great as the addition to the earth's action by the sun in the quarters; so that, upon the whole, the power of the earth on the moon is diminished by the sun, and therefore is most diminished when that action is strongest: but as the earth, by its approach to the sun, has its influence lessened, the moon, being less attracted, will gradually recede from the earth; and as the earth, in its recess from the sun, recovers by degrees its former power, the orbit of the moon must again contract. Two consequences follow from hence, viz. that the moon will be more remote from the earth when the latter is nearest the sun, and also will take up a longer time in performing its revolution through the dilated orbit than through the more contracted.

These irregularities would be produced if the moon, without being acted upon unequally by the sun, should describe a perfect circle about the earth and in the plane of its motion; but though neither of these circumstances take place, yet the abovementioned inequalities occur only with some little variation with regard to the degree of them; but some others are observed to take place from the moon's motion being performed in the manner already described: For, as the moon describes an ellipsis, having the earth in one of its foci, this curve will be subjected to various changes, neither preserving constantly the same figure nor position; and because the plane of this ellipsis is not the same with that of the earth's orbit, it thence follows, that the former will continually change; so

Fig. 149

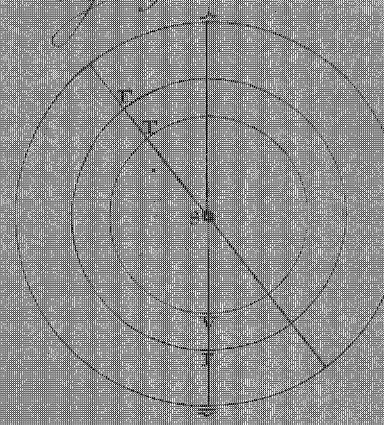


Fig. 147

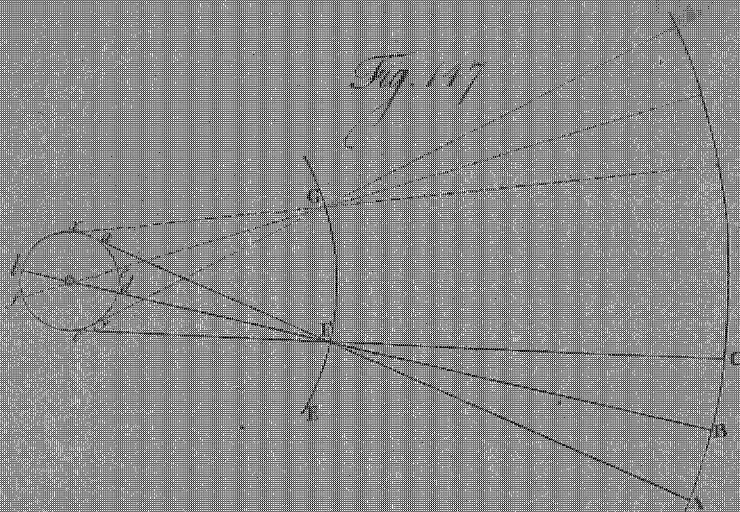


Fig. 148

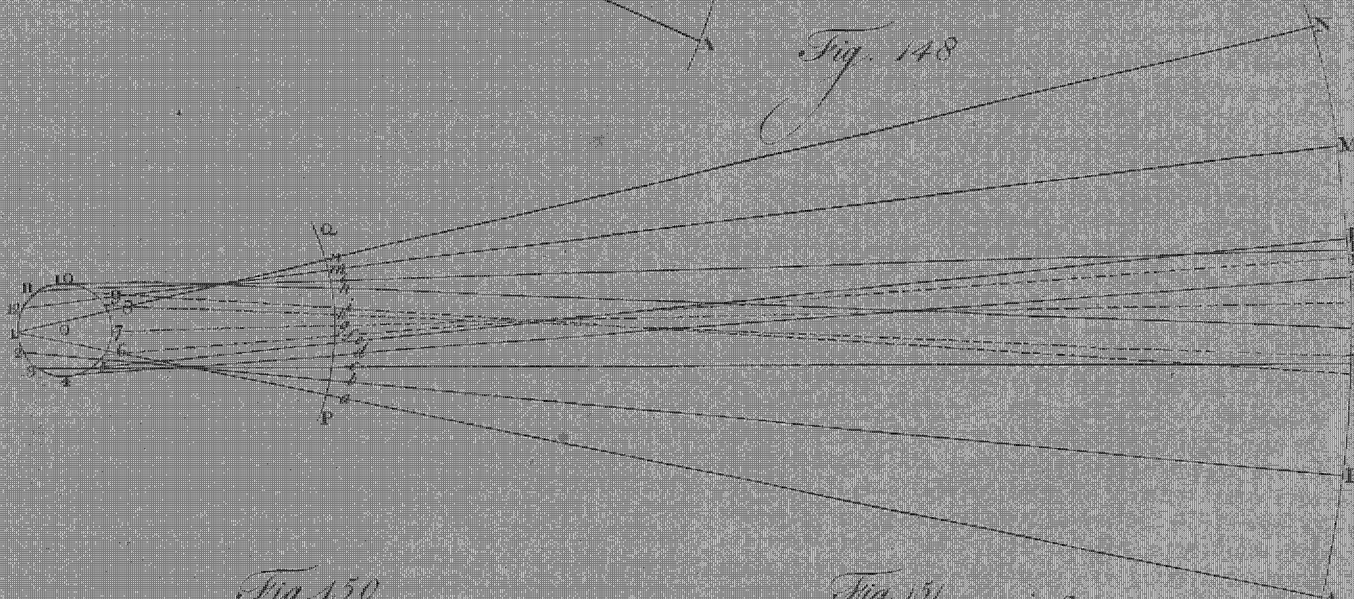


Fig. 150
Ptolemaic System

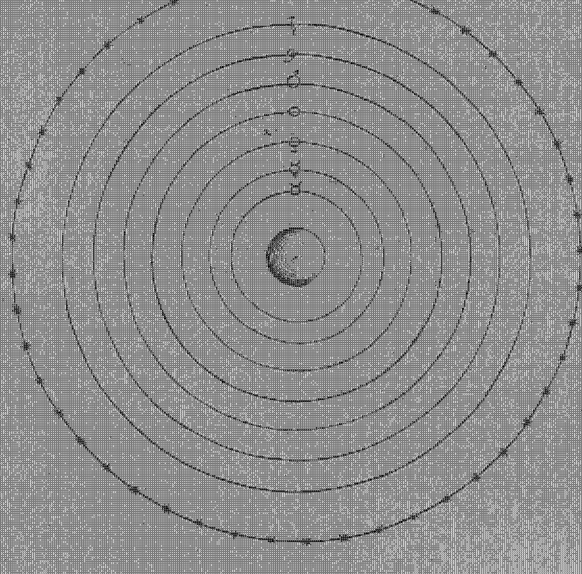
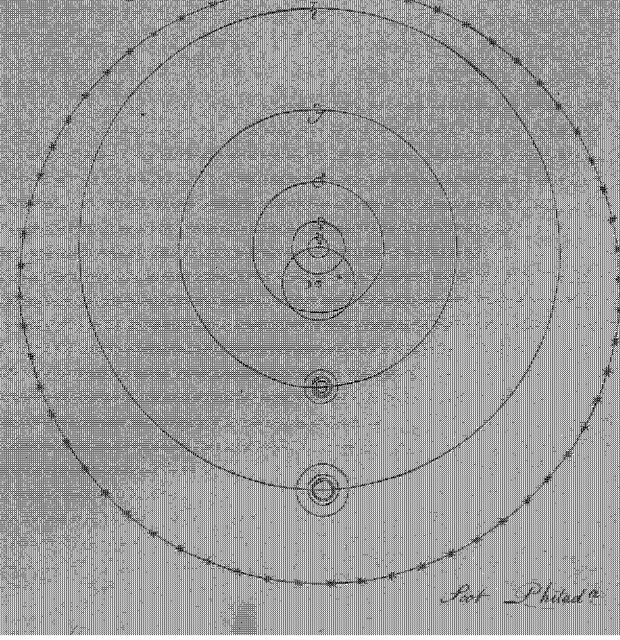


Fig. 151
Tychonic System



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that neither the inclination of the two planes towards each other, nor the line in which they interfect, will remain for any length of time unaltered.

286 Action of the fun caufes the plane of the moon's orbit to change.

As the moon does not move in the fame plane with the earth, the fun is but feldom in the plane of her orbit, viz. only when the line made by the common interfection of the two planes, if produced, will pafs through the fun. Thus, let S, in fig. 125. denote the fun, T the earth, ATB the plane of the earth's orbit, CDEF the moon's orbit; the part CDE being raifed above, and the part CFE depreffed under the former. Here the line CE, in which the two planes interfect each other, being continued, paffes through the fun in S. When this happens, the action of the fun is directed in the plane of the moon's orbit, and cannot draw her out of this plane, as will evidently appear from an infpection of the figure; but in other cafes the obliquity of the fun's action to the plane of the orbit will caufe this plane continually to change.

Let us now fuppofe, in the firft place, the line in which the two planes interfect each other to be perpendicular to the line which joins the earth and fun. Let T, in fig. 126, 127, 128, 129. reprefent the earth; S the fun; the plane of the fcheme the plane of the earth's orbit, in which both the fun and earth are placed. Let AC be perpendicular to ST, which joins the earth and fun; and let the line AC be that in which the plane of the moon's orbit interfects the orbit of the earth. On the centre T defcribe in the plane of the earth's motion the circle ABCD; and in the plane of the moon's orbit defcribe the circle AECF; one-half of which, AEC, will be elevated above the plane of this fcheme, and the other half, AFC, as much depreffed below it. Suppofe then the moon to fet out from the point A, in fig. 127. in the direction of the plane AEC. Here fhe will be continually drawn out of this plane by the action of the fun; for this plane AEC, if extended, will not pafs through the fun, but above it; fo that the fun, by drawing the moon directly toward itfelf, will force it continually more and more from that plane towards the plane of the earth's motion in which itfelf is, caufing it to defcribe the line AKGHI, which will be convex to the plane AEC and concave to the plane of the earth's motion. But here this power of the fun, which is faid to draw the moon toward the plane of the earth's motion, muft be underftood principally of as much only of the fun's action upon the moon as it exceeds the action of the fame upon the earth: For fuppofe the laft mentioned figure to be viewed by the eye placed in the plane of that fcheme; and in the line CTA, on the fide A, will appear as the ftraight line TDB in fig. 130. and the plane AECF as another ftraight line FE, and the curve line AKGHI under the form of the line TKGHI. Now it is plain, that the earth and moon being both attracted by the fun, if the fun's action upon both was equally ftrong, the earth T, and with it the plane AECF, or the line FTE, would be carried towards the fun with as great velocity as the moon, and therefore the moon not drawn out of it by the fun's action, except only from the fmall obliquity of direction of this action upon the moon to that of the fun's action upon the earth, which arifes from the moon being out of the plane of the earth's motion, and is not confiderable; but the action of the fun upon the moon being greater than upon the earth all the time the moon is nearer to the fun than the earth is, it will be drawn from the plane AEC, or the line TE, by that excefs, and made to defcribe the curve line AGI or TGI. But it is the cuftom of aftronomers, inftead of confidering the moon as moving in fuch a curve line, to refer its motion continually to the plane which touches the true line wherein it moves at the point where at any time the moon is. Thus, when the moon is in the point A, its motion is confidered as being in the plane AEC, in whofe direction it then attempts to move; and when in the point K, fig. 127. its motion is referred to the plane which paffes through the earth and touches the line AKGHI in the point K. Thus the moon, in paffing from A to I, will continually change the plane of her motion in the manner we fhall now more particularly explain.

Let the plane which touches the line AKI in the point K, fig. 127. interfect the plane of the earth's orbit in the line LTM. Then, becaufe the line AKI is concave to the plane ABC, it falls wholly between that plane and the plane which touches it in K; fo that the plane MKL will cut the plane AEC before it meets the plane of the earth's motion, fuppofe in the line YT, and the point A will fall between K and L. With a radius equal to TY or TL defcribe the femicircle LYM. Now, to a fpectator on the earth, the moon when in A will appear to move in the circle AECF; and when in K, will appear to be moving in the femicircle LYM. The earth's motion is performed in the plane of this fcheme; and to a fpectator on the earth the fun will always appear to move in that plane. We may therefore refer the apparent motion of the fun to the circle ABCD defcribed in this plane about the earth. But the points where this circle in which the fun feems to move interfects the circle in which the moon is feen at any time to move, are called the nodes of the moon's orbit at that time. When the moon is feen moving in the circle AECD, the points A and C are the nodes of the orbit; when fhe appears in the femicircle LYM, then L and M are the nodes. It will now appear, from what has been faid, that while the moon has moved from A to K, one of the nodes has been carried from A to L, and the other as much from C to M. But the motion from A to L and from C to M is backward in regard to the motion of the moon, which is the other way from A to K, and from thence toward C. Again, the angle which the plane wherein the moon at any time appears makes with the plane of the earth's motion, is called the inclination of the moon's orbit at that time: we fhall now therefore proceed to fhow, that this inclination of the orbit, when the moon is in K, is lefs than when fhe was in A; or, that the plane LYM, which touches the line of the moon's motion in K, makes a lefs angle with the plane of the earth's motion, or with the circle ABCD, than the plane AEC makes with the fame. The femicircle LYM interfects the femicircle AEC in Y, and the arch AY is lefs than LY, and both together lefs than half a circle. But it is demonftrated by fpheric geometry, that when a triangle is made as here, by three arches of circles AL, AY, and YL, the angle under YAB without the triangle is greater than the angle YLA within, if the two arches AY, YL, taken together,

287 Nodes of the moon's orbit.

288 Inclination of her orbit.

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ther, do not amount to a semicircle. If the two arches make a complete semicircle, the two angles will be equal; but if the two arches taken together exceed a semicircle, the inner angle YLA is greater than the other. Here then the two arches AY and LY together being less than a semicircle, the angle under ALY is less than the angle under BAE. But from the doctrine of the sphere it is also evident, that the angle under ALY is equal to that in which the plane of the circle LYKM, that is, the plane which touches the line AKGHI in K is inclined to the plane of the earth's motion ABC; and the angle under BAE is equal to that in which the plane AEC is inclined to the same plane. Therefore the inclination of the former plane is less than that of the latter. Suppose, now, the moon to be advanced to the point G in fig. 128. and in this point to be distant from its node a quarter part of the whole circle; or, in other words, to be in the mid-way between its two nodes. In this case the nodes will have receded yet more, and the inclination of the orbit be still more diminished: for suppose the line AKGHI to be touched in the point G by a plane passing through the earth T, let the intersection of this plane with the plane of the earth's motion be the line WTO, and the line TP its intersection with the plane LKM. In this plane let the circle NGO be described with the semidiameter TP or NT cutting the other circle LKM in P. Now, the line AKGI is convex to the plane LKM which touches it in K; and therefore the plane NGO, which touches it in G, will intersect the other touching plane between G and K; that is, the point P will fall between these two points, and the plane continued to the plane of the earth's motion will pass beyond L; so that the points N and O, or the places of the nodes when the moon is in G, will be farther from A and C than L and M; that is, will have moved farther backward. Besides, the inclination of the plane NGO to the plane of the earth's motion ABC is less than the inclination of the plane LKM to the same; for here also the two arches LP and NP, taken together, are less than a semicircle, each of them being less than a quadrant, as appears, because GN, the distance of the moon in G from its node N, is here supposed to be a quarter part of a circle. After the moon is passed beyond G, the case is altered: for then these arches will be greater than quarters of a circle; by which means the inclination will be again increased, though the nodes still go on to move the same way. Suppose the moon in H (fig. 129), and that the plane which touches the lines AKGI in H intersects the plane of the earth's motion in the line QTR, and the plane NGO in the line TV, and besides, that the circle QHR be described in that plane: then, for the same reason as before, the point V will fall between H and G, and the plane RVQ will pass beyond the last plane OVN, causing the points Q and K to fall farther from A and C than N and O. But the arches NV, VQ are each greater than the quarter of a circle; consequently the angle under BQV will be greater than that under BNV. Lastly, when the moon is by this attraction of the sun drawn at length into the plane of the earth's orbit, the node will have receded yet more, and the inclination be so much increased, as to become somewhat more than at first: for the line AKGHI being convex to all the planes which touch it, the part HI will wholly fall between the plane QVR and the plane ABC; so that the point I will fall between B and R; and, drawing ITW, the point W, will be farther removed from A than Q. But it is evident, that the plane which passes through the earth T and touches the line AGI in the point I, will cut the plane of the earth's motion ABCD in the line ITW, and be inclined to the same in the angle under HIB; so that the node which was first in A, after having passed into L, N, and Q, comes at last into the point W, as the node which was at first in C has passed from thence successively through the points M, O, and R, to I. But the angle HIB, which is now the inclination of the orbit to the plane of the ecliptic, is manifestly not less than the angle under ECB or EAB, but rather something greater. Thus the moon, while it passes from the plane of the earth's motion in the quarter, till it comes again into the same plane, has the nodes of its orbit continually moved backward, and the inclination of it at first diminished till it comes to G in fig. 128, which is near to its conjunction with the sun, but afterwards is increased again almost by the same degrees, till upon the moon's arrival again to the plane of the earth's motion the inclination of the orbit is restored to something more than its first magnitude, though the difference is not very great, because the points I and C are not so far distant from each other.

In like manner, if the moon had departed from the quarter at C, it should have described the curve line CXW in fig. 126. between the planes AFC and ADC, which would be convex to the former planes and concave to the latter; so that here also the nodes would continually recede, and the inclination of the orbit gradually diminish more and more, till the moon arrived near its opposition to the sun in X; but from that time the inclination should again increase till it become a little greater than at first. This will easily appear by considering, that as the action of the sun upon the moon, by exceeding its action upon the earth, drew it out of the plane AEC towards the sun, while the moon passed from A to I; so during its passage from C to W, the moon being all that time farther from the sun than the earth, it will be attracted less; and the earth together with the plane AECF, will as it were be drawn from the moon, in such a manner, that the path the moon describes shall appear from the earth as it did in the former case by the moon being drawn away. 286

Motion of the nodes explained.

Such are the changes which the nodes and inclination of the moon's orbit undergo when the nodes are in the quarters; but when the nodes by their motion, and the motion of the sun together, come to be situated between the quarter and conjunction or opposition, their motion and the change made in the inclination of the orbit are somewhat different.—Let AGH, in fig. 131. be a circle described in the plane of the earth's motion, having the earth in T for its centre, A the point opposite to the sun, and G a fourth part of the circle distant from A. Let the nodes of the moon's orbit be situated in the line BTD, and B the node falling between A, the place where the moon would be in the full, and G the place where she would be in the quarter. Suppose BEDF to be the plane in which the moon attempts to move when it proceeds from the point B; then, because the moon in B is more distant

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distant from the sun than the earth, it will be less attracted by the sun, and will not descend towards the sun so fast as the earth, consequently it will quit the plane BEDF, which is supposed to accompany the earth, and describe the line BIK convex to it, till such time as it comes to the point K, where it will be in the quarter; but from thenceforth being more attracted than the earth, the moon will change its course, and the following part of the path it describes will be concave towards the plane BED or BGD, and continue concave to the plane BGD till it crosses that plane in L, just as in the preceding case. Now, to show that the nodes, while the moon is passing from B to K, will proceed forward, or move the same way with the moon, and at the same time the inclination of the orbit will increase when the moon is in the point I, let the line MIN pass through the earth T, and touch the path of the moon in I, cutting the plane of the earth's motion in the line MTN, and the line BED in TO. Because the line BIK is convex to the plane BED, which touches it in B, the plane NIM must cross the plane DEB before it meets the plane CGB; and therefore the point M will fall from G towards B; and the node of the moon's orbit being translated from B towards M is moved forward.

Again, the angle under OMG, which the plane MON makes with the plane BGC, is greater than the angle OBG, which the plane BOD makes with the same. This appears from what has been already demonstrated, because the arches BO and OM are each of them less than the quarter of a circle; and therefore, taken both together are less than a semicircle. But further, when the moon is come to the point K in its quarter, the nodes will be advanced yet further forward, and the inclination of the orbit also more augmented. Hitherto we have referred the moon's motion to the plane which, passing through the earth, touches the path of the moon in the point where the moon is, as we have already said that the custom of astronomers is. But in the point K no such plane can be found: on the contrary, seeing the line of the moon's motion on one side the point K is convex to the plane BED, and on the other side concave to the same, so that no plane can pass through the points T and K, but will cut the line BKL in that point; therefore, instead of such a touching plane, we must make use of PKQ, which is equivalent, and with which the line BKL shall make a less angle than with any other plane; for this does as it were touch the line BK in the point K, since it cuts it in such a manner that no other plane can be drawn so as to pass between the line BK and the plane PKQ. But now it is evident, that the point P, or the node, is removed from M towards G, that is, has moved yet farther forwards; and it is likewise as manifest, that the angle under KPG, or the inclination of the moon's orbit in the point K, is greater than the angle under IMG for the reason already given.

After the moon has passed the quarter, her plane being concave to the plane AGCH, the nodes will recede as before till she arrives at the point L; which shows, that, considering the whole time of the moon's passing from B to L, at the end of that time the nodes shall be found to have receded, or to be placed more backward, when the moon is in L than when it was in B: for the moon takes a longer time in passing from K to L than in passing from B to K; and therefore the nodes continue to recede a longer time than they moved forwards; so that their recess must surmount their advance. In the same manner, while the moon is in its passage from K to L, the inclination of the orbit shall diminish till the moon come to the point in which it is one quarter part of a circle distant from its node, suppose in the point R; and from that time the inclination will again increase. Since, therefore, the inclination of the orbit increases while the moon is passing from B to K, and diminishes itself again only while the moon is passing from K to R, then augments again while the moon passes from B to L; it thence comes to be much more increased than diminished, and thus will be distinguishably greater, when the moon comes to L than when it sets out from B. In like manner, when the moon is passing from L on the other side the plane AGCH, the node will advance forward as long as the moon is between the point L and the next quarter; but afterwards it will recede till the moon comes to pass the plane AGCH again, in the point V between B and A: and because the time between the moon's passing from L to the next quarter is less than the time between that quarter and the moon's coming to the point V, the node will have receded more than it has advanced; so that the point V will be nearer to A than L is to C. So also the incination of the orbit, when the moon is in V, will be greater than when she was in L: for this inclination increases all the time the moon is betwixt L and the next quarter, decreasing only when she is passing from this quarter to the mid-way between the two nodes, and from thence increases again during the whole passage through the other half of the way to the next node.

In this manner we see, that at every period of the moon the nodes will have receded, and thereby have approached towards a conjunction with the sun; but this will be much forwarded by the motion of the earth, or the apparent motion of the sun himself. In the last scheme the sun will appear to have moved from S towards W. Let us suppose it had appeared to have moved from S to W while the moon's node has receded from B to V: then drawing the line WTX, the arch VX will represent the distance of the line drawn between the nodes from the sun when the moon is in V; whereas the arch BA represented that distance when the moon was in B. This visible motion of the sun is much greater than that of the node; for the sun appears to revolve quite round in one year, while the node is near nineteen in making its revolution. We have also seen, that when the moon was in the quadrature, the inclination of her orbit decreased till she came to the conjunction or opposition, according to the node it set out from; but that afterwards it again increased till it became at the next node rather greater than at the former. When the node is once removed from the quarter nearer to a conjunction with the sun, the inclination of the moon's orbit when she comes into the node is more sensibly greater than it was in the node preceding; the inclination of the orbit by this means more and more increasing till the node comes into conjunction with the sun: at which time it has been shown that the latter has no power to

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change the plane of her orbit. As soon, however, as the nodes are got out of conjunction towards the other quarters, they begin to recede as before; but the inclination of the orbit in the appulse of the moon to each succeeding node is less than at the preceding, till the nodes come again into the quarters. This will appears as follows: Let A, in fig. 132. represent one of the moon's nodes placed between the point of opposition B and the quarter C. Let the plane ADE pass through the earth T, and touch the path of the moon in A. Let the line AFGH be the path of the moon in her passage from A to H, where she crosses again the plane of the earth's motion. This line will be convex towards the plane ADE, till the moon comes to G, where she is in the quarter; and after this, between G and H, the same line will be concave towards this plane. All the time this line is convex towards the plane ADE, the nodes will recede; and, on the contrary, move forward when the line is concave towards that plane. But the moon is longer in passing from A to G, and therefore the nodes go backward farther than they proceed; and therefore, on the whole, when the moon has arrived at H, the nodes will have receded, that is, the point H will fall between B and E. The inclination of the orbit will decrease till the moon is arrived at the point F in the middle between A and H. Through the passage between F and G the inclination will increase, but decrease again in the remaining part of the passage from G to H, and consequently at H must be less than at A. Similar effects, both with respect to the nodes and inclination of the orbit, will take place in the following passage of the moon on the other side of the plane ABEC from H, till it comes over that plane again in I.

Thus the inclination of the orbit is greatest when the line drawn between the moon's nodes will pass through the sun, and least when this line lies in the quarters; especially if the moon at the same time be in conjunction with the sun, or in the opposition. In the first of these cases the nodes have no motion; in all others, the nodes will each month have receded: and this retrograde motion will be greatest when the nodes are in the quarters, for in that case they will have no progressive motion during the whole month; but in all other cases they at some times go forward, viz. whenever the moon is between either of the quarters and the node which is less distant from that quarter than the fourth part of a circle.

290 Irregularities arising from the moon's motion in an ellipsis.

We have now only to explain those irregularities of the lunar motion which arise from her motion in an ellipsis. From what has been already said it appears, that the earth acts on the moon in the reciprocal duplicate proportion of the distance; therefore the moon, if undisturbed by the sun, would move round the earth in a true ellipsis, and a line drawn from the earth to the sun would pass over equal spaces in equal times. We have, however, already shown, that this equality is disturbed by the sun, and likewise how the figure of the orbit is changed each month; that the moon is nearer the earth at the new and full, and more remote in the quarters, than it would be without the sun. We must, however, pass by those monthly changes, and consider the effect which the sun will have in the different situations of the axis of the orbit in respect of that luminary. This action varies the force wherewith the moon is drawn towards the earth. In the quarters the force of the earth is directly increased by the sun, but diminished at the new and full; and in the intermediate places the influence of the earth is sometimes lessened, sometimes assisted, by the action of that luminary. In these intermediate places, however, between the quarters and the conjunction or opposition, the sun's action is so oblique to that of the earth on the moon, as to produce that alternate acceleration and retardation of her motion so oftened mentioned. But besides this effect, the power by which the moon attracts the earth towards itself, will not be at full liberty to act with the same force as if the sun acted not at all on the moon; and this effect of the sun's action, whereby it corroborates or weakens the action of the earth, is here only to be considered; and by means of this influence it comes to pass, that the power by which the moon is impelled towards the earth is not perfectly in the reciprocal duplicate proportion of the distance, and of consequence the moon will not describe a perfect ellipsis. One particular in which the lunar orbit will differ from a perfect elliptical figure, consists in the places where the motion of the moon is perpendicular to the line drawn from itself to the earth. In an ellipsis, after the moon should have set out in the direction perpendicular to this line, drawn from itself to the earth, and at its greatest distance from the earth, its motion would again become perpendicular to this line drawn between itself and the earth, and the moon be at its nearest distance from the earth, when it should have performed half its period; after having performed the other half period of its motion, would again become perpendicular to the forementioned line, and the moon return to the place whence it set out, and have recovered again its greatest distance. But the moon in its real motion, after setting out as before, sometimes makes more than half a revolution before its motion comes again to be perpendicular to the line drawn from itself to the earth, and the moon is at its nearest distance; and then performs more than another half of an entire revolution before its motion can a second time recover its perpendicular direction to the line drawn from the moon to the earth, and the former arrive again at its greatest distance from the earth. At other times the moon will descend to her nearest distance before she has made half a revolution, and recover again its greatest distance before it has made an entire revolution. The place where the moon is at its greatest distance is called the *moon's apogeon*, and the place of her nearest distance her *perigeon*; and this change of place, where the moon comes successively to its greatest distance from the earth, is called the *motion of the apogeon*. The manner in which this motion of the apogeon is caused by the sun comes now to be explained. 291

291 Apogeon and perigeon of the moon.

Sir Isaac Newton has shown, that if the moon were attracted toward the earth by a composition of two powers, one of which were reciprocally in the duplicate proportion of the distance from the earth, and the other reciprocally in the triplicate proportion of the same distance; then, though the line described by the moon would not be in reality an ellipsis, yet the moon's motion might be perfectly explained by an ellipsis whose axis should be made to move round the earth; this motion being in consequence, as astronomers express themselves, that is, the same way as the moon itself moves,

Motions of the Secondary Planets.

moves, if the moon be attracted by the sum of the two powers; but the axis must move in antecedence, or the contrary way, if the moon be acted upon by the difference of these forces. We have already explained what is meant by duplicate proportion, namely, that if three magnitudes, as A, B, and C, are so related that the second B bears the same proportion to the third C as the first A bears to the second B; then the proportion of the first A to the third C is the duplicate of the proportion of the first A to the second B. Now if a fourth magnitude as D be assumed, to which C shall bear the same proportion as A bears to B, and B to C; then the proportion of A to D is the triplicate of the proportion of A to B.

292 Motion in antecedence and consequence explained.

293 Triplicate proportion explained.

294 Motion of the moon's apogeon determined.

Let now T (fig. 133. 134.) denote the earth, and suppose the moon in the point A its apogeon or greatest distance from the earth, moving in the direction AF perpendicular to AB, and acted upon from the earth by two such forces as already mentioned. By that power alone, which is reciprocally in the duplicate proportion of the distance, if the moon set out with a proper degree of velocity, the ellipsis AMB may be described: but if the moon be acted upon by the sum of the forementioned powers, and her velocity in the point A be augmented in a certain proportion; or if that velocity be diminished in a certain proportion *, and the moon be acted upon by the difference of those powers; in both these cases the line AE, which shall be described by the moon, shall thus be determined. Let the point M be that into which the moon would have arrived in any given point of time, had it moved in the ellipsis AMB; draw MT and likewise CTD in such a manner that the angle ATM shall bear the same proportion to the angle under ATC as the velocity with which the ellipsis must have been described bears to the difference between this velocity and that with which the moon must set out from the point A, in order to describe the path AE. Let the angle ATC be taken toward the moon, as in fig. 133. if the moon be attracted by the sum of the powers; but the contrary way (as in fig. 134.) if by their difference. Then let the line AB be moved into the position CD, and the ellipsis AMB into the situation CND, so that the point M be translated to L; then the point L shall fall upon the path of the moon AE. Now the angular motion of the line AT, whereby it is removed into the situation CT, represents the motion of the apogeon; by the means of which the motion of the moon might be fully explained by the ellipsis AMB, if the action of the sun upon it was directed to the centre of the earth, and reciprocally in the triplicate proportion of the moon's distance from it; but that not being so, the motion of the apogeon will not proceed in the regular manner now described. It is, however, to be observed here, that in the first of the two preceding cases, where the apogeon moves forward, the whole centripetal power increases faster, with the decrease of distance, than if the entire power were reciprocally in the duplicate proportion of the distance; because one part only is already in that proportion, and the other part, which is added to this to make up the whole power, increases faster with the decrease of distance. On the other hand, when the centripetal power is the difference between these two bodies, it increases less with the decrease of the distance, than if it were simply in the reciprocal duplicate proportion of the distance. Therefore, if we choose to explain the moon's motion by an ellipsis, which may be done without any sensible error, we may collect in general, that when the power by which the moon is attracted to the earth, by varying the distance, increases in a greater than the duplicate proportion of the distance diminished, a motion in consequence must be ascribed to the apogeon; but that when the attraction increases in a smaller proportion than that just mentioned, the apogeon must have given to it a motion in antecedence. It is then observed by Sir Isaac Newton, that the former of these cases obtains when the moon is in the conjunction and opposition, and the latter when she is in the quarters; so that in the former the apogeon moves according to the order of the signs; in the other, the contrary way. But, as has been already mentioned, the disturbance given to the action of the earth by the sun in the conjunction and opposition, being near twice as great as in the quarters, the apogeon will advance with a greater velocity than recede, and in the compass of a whole revolution of the moon will be carried in consequence.

* See *Newton's Principia*, book i. prop. 44. corol. 2.

295 Inequality of the motion of the apogeon.

Sir Isaac shows, in the next place, that when the line AB coincides with the line that joins the sun and earth, the progressive motion of the apogeon, when the moon is in conjunction or opposition, exceeds the retrograde, in the quadratures, more than in any other situation of the line AB. On the contrary, when the line AB makes right angles with that which joins the earth and sun, the retrograde motion will be more considerable, nay, is found so great as to exceed the progressive; so that in this case the apogeon, in the compass of an entire revolution of the moon, is carried in antecedence. Yet from the considerations already mentioned, the progressive motion exceeds the other; so that on the whole, the motion of the apogeon is in consequence. The line AB also changes its situation with that which joins the earth and sun by such slow degrees, that the inequalities of the motion of the apogeon, arising from this last consideration, are much greater than what arise from the other.

296 Occasions another inequality in the eccentricity of the moon's orbit.

This unsteady motion of the apogeon gives rise to another inequality in the motion of the moon herself, so that it cannot at all times be explained by the same ellipsis. For whenever the apogeon moves in consequence, the motion of the luminary must be referred to an orbit more eccentric than what the moon would describe, if the whole power by which the moon was acted upon in its passing from the apogeon changed according to the reciprocal duplicate proportion of its distance from the earth, and by that means the moon did describe an immoveable ellipsis: and when the apogeon moves in antecedence, the moon's motion must be referred to an orbit less eccentric. In the former of the two figures last referred to, the true place of the moon L falls without the orbit AMB, to which its motion is referred: whence the orbit ALE truly described by the moon, is less incurvated in the point A than is the orbit AMB; therefore this orbit is more oblong, and differs farther from a circle than the ellipsis would, whose curvature in A were equal to that of the line ALB: that is, the proportion of the distance of the earth T from the centre of the ellipsis to its axis, will be greater in AMB than in the other; but that

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that other is the ellipsis which the moon would describe, if the power acting upon it in the point A were altered in the reciprocal duplicate proportion of the distance; and consequently the moon being drawn more forcibly towards the earth, it will descend nearer to it. On the other hand, when the apogeon recedes, the power acting on the moon increases with the decrease of distance, in less than the duplicate proportion of the distance, and therefore the moon is less impelled towards the earth, and will not descend so low. Now, suppose, in the former of these figures, that the apogeon A is in the situation where it is approaching towards the conjunction or opposition of the sun; in this case its progressive motion will be more and more accelerated. Here suppose the moon, after having descended from A through the orbit AE as far as F, where it is come to its nearest distance from the earth, ascends again up the line FG. As the motion of the apogeon is here more and more accelerated, it is plain that the cause of its motion must also be on the increase; that is, the power by which the moon is drawn to the earth, will decrease with the increase of the moon's distance in her ascent from F, in a greater proportion than that wherewith it is increased with the decrease of distance in the moon's descent to it. Consequently the moon will ascend to a greater distance than AT from whence it is descended; therefore the proportion of the greatest distance of the moon to the least is increased. But further, when the moon again descends, the power will increase yet farther with the decrease of distance than in the last ascent it increased with the agmentation of distance. The moon therefore must descend nearer to the earth than it did before, and the proportion of the greatest distance to the least be yet more increased. Thus, as long as the apogeon is advancing to the conjunction or opposition, the proportion of the greatest distance of the moon from the earth to the least will continually increase; and the elliptical orbit to which the moon's motion is referred, will become more and more eccentric. As soon, however, as the apogeon is passed the conjunction or opposition with the sun, its progressive motion abates, and with it the proportion of the greatest distance of the moon from the earth to the least will also diminish: and when the apogeon becomes retrograde, the diminution of this proportion will be still farther continued on, till the apogeon comes into the quarter; from thence this proportion, and the eccentricity of the orbit, will increase again. Thus the orbit of the moon is most eccentric when the apogeon is in conjunction with the sun, or in opposition to it, and least of all when the apogeon is in the quarters. These changes in the nodes, the inclination of the orbit to the plane of the earth's motion, in the apogeon and in the eccentricity, are varied like the other inequalities in the motion of the moon, by the different distance of the earth from the sun being greatest when their cause is greatest; that is, when the earth is nearest the sun. Sir Isaac

297 Computation of the lunar inequalities

Newton has computed the very quantity of many of the moon's inequalities. That acceleration of the moon's motion which is called the variation, when greatest, removes the luminary out of the place in which it would otherwise be found, somewhat more than half a degree. If the moon, without disturbance from the sun, would have described a circle concentrical to the earth, his action would cause her approach nearer in the conjunction and opposition than in the quarters, nearly in the proportion of 69 to 70. It has already been mentioned, that the nodes perform their period in almost 19 years. This has been found by observation; and the computations of Sir Isaac assign to them the same period. The inclination of the moon's orbit, when least, is an angle about one-eighteenth of that which constitutes a right angle; and the difference between the greatest and least inclination is about one-eighteenth of the least inclination, according to our author's computations: which is also agreeable to the general observations of astronomers. The motion of the apogeon and the changes in the eccentricity have not been computed by Sir Isaac.

298 How to compute the inequalities of the motions of Jupiter's satellites.

The same incomparable geometer shows how, by comparing the periods of the motions of the satellites which revolve round Jupiter and Saturn with the period of our moon round the earth, and the periods of those planets round the sun with our earth's motion, the inequalities in the motion of those satellites may be computed from those of our moon, excepting only the motion of the apogeon; for the orbits of those satellites, as far as can be discerned by us at this distance, appearing little or nothing eccentric, this motion, as deduced from the moon, must be diminished.

Nature and Motions of the Comets.

§ 4. *Of the Nature and Motions of the Comets.*

That these bodies are not meteors in our air is manifest, because they rise and set in the same manner as the moon and stars. The astronomers have gone so far in their inquiries concerning them as to prove by their observations that they moved in the celestial spaces beyond the moon; but they had no notion of the path which they described. Before the time of our author, it was supposed that they moved in straight lines; and Des Cartes, finding that such a motion would interfere with his vortices, removed them entirely out of the solar system. Sir Isaac Newton, however, distinctly proves from astronomical observation, that the comets pass through the planetary regions, and are generally invisible at a smaller distance than that of Jupiter. Hence, finding that they were evidently within the sphere of the sun's action, he concludes, that they must necessarily move about the sun as the planets do; and he proves, that the power of the sun being reciprocally in the duplicate proportion of the distance, every body acted upon by him must either fall directly down, or move about him in one of the conic sections, viz. either the ellipsis, parabola, or hyperbola. If a body which descends towards the sun as low as the orbit of any planet, move with a swifter motion than the planet, it will describe an orbit of a more oblong figure than that of the planet, and have at least a longer axis. The velocity of the body may be so great, that it shall move in a parobola; so that having once passed the sun, it shall ascend for ever without returning, though the sun will still continue in the focus of that parabola; and with a velocity still greater, they will move in an hyberbola. It is, however, most probable, that the comets move in very eccentric ellipsis, such as is represented in fig. 135. where S represents the sun, C the comet, and ABDE its orbit; wherein the distance of S and D far exceeds that of S and A. Hence those bodies are sometimes found at a moderate distance from the sun, and appear within

299 Comets generally invisible until they come nearer than Jupiter.

Nature and Motions of the Comets.

within the planetary regions; at other times they aſcend to vaſt diſtances, far beyond the orbit of Saturn, and thus become inviſible.

300 *They move in eccentric ellipſes.*

That the comets do move in this manner is proved by our author from computations built upon the obſervations made by many aſtronomers. Theſe computations were made by Sir Iſaac Newton himſelf upon the comet which appeared toward the latter end of the year 1680 and beginning of 1681, and the ſame were proſecuted more at large by Dr Halley upon this and other comets. They depend on this principle, that the eccentricity of the orbits of the comets is ſo great, that if they are really elliptical, yet that part of them which comes under our view approaches ſo near to a parabola that they may be taken for ſuch without any ſenſible error, as in the foregoing figure the parabola FAG, in the lower part of it about A, differs very little from the ellipſis DEAB; on which foundation Sir Iſaac teaches a method of finding the parabola in which any comet moves, by three obſervations made upon it in that part of its orbit where it agrees neareſt with a parabola: and this theory is confirmed by aſtronomical obſervations; for the places of the comets may thus be computed as exactly as thoſe of the primary planets.

301 *How to calculate the motion of a comet.*

Our author afterwards ſhows how to make uſe of any ſmall deviation from the parabola which may be obſerved, to determine whether the orbits of the comets be elliptical or not; and thus to know whether or not the ſame comet returns at different ſeaſons. On examining by this rule the comet of 1680, he found its orbit to agree more exactly with an ellipſis than a parabola, tho' the ellipſis be ſo very eccentric, that it cannot perform its revolution in 500 years. On this Dr Halley obſerved, that mention is made in hiſtory of a comet with a ſimilar large tail, which appeared three ſeveral times before. The firſt was before the death of Julius Cæſar; and each appearance happened at the interval of 575 years, the laſt coinciding with the year 1680. He therefore calculated the motion of this comet to be in ſuch an eccentric orbit, that it could not return in leſs than 575 years; which computations agree yet more perfectly with the obſervations made on this comet than any parabolic orbit will do. To compare together different appearances of the ſame comet, is indeed the only method of diſcovering with certainty the form of its orbit; for it is impoſſible to diſcover the form of one ſo exceedingly eccentric from obſervations taken in a ſmall part of it. Sir Iſaac Newton therefore propoſes to compare the orbits, on the ſuppoſition that they are parabolical, of ſuch comets as appear at different times, for if we find the ſame orbit deſcribed by a comet at different times, in all probability it will be the ſame comet that deſcribes it. Here he remarks from Dr Halley, that the ſame orbit very nearly agrees to two appearances of a comet about the ſpace of 75 years diſtance; ſo that if theſe two appearances were really of the ſame comet, the tranſverſe axis of its orbit would be 18 times that of the axis of the earth's orbit; and therefore, when at its greateſt diſtance from the ſun, this comet would be removed not leſs than 35 times the mean diſtance of the earth from the ſame luminary.

Even this is the leaſt diſtance aſſigned by our author to any comet in its greateſt elongation from the ſun; and on the foundation of Dr Halley's computations it was expected in the year 1758 or 1759.

I

The Aſtronomer Royal advertiſes us of the expected return of the comet of 1532 and 1661, in the latter end of the year 1788, or beginning of 1789, in the following particulars.

"The elements of the orbits of the comets obſerved by Apian in 1532, and by Hevelius in 1661, are ſo much alike as to have induced Mr Halley to ſuppoſe them to be one and the ſame comet; and aſtronomers ſince have joined in the ſame opinion. Hence it ſhould return to its perihelium the 27th of April 1789. But from the diſturbances of the planets, it will probably come a few months ſooner. It will firſt be ſeen in the ſouthern parts of the heavens, if any aſtronomers ſhould watch for it in ſituations near the line, or in ſouthern climates, in the courſe of the year 1788, and probably not before the month of *September*. Aſtronomers who may happen to be in thoſe parts will be enabled to direct their teleſcopes for diſcovering it as early as poſſible, by being furniſhed with the following elements of its orbit:

The perihelium diſtance	0.44851
Place of aſcending node	$2^s\ 24^\circ\ 18'$
Inclination of the orbit to the ecliptic	$32^\circ\ 36'$
Perihelium forwarder in the orbit than the aſcending node	$33^\circ\ 28'$

time of the perihelium in the latter end of the year 1788, or beginning of 1789. Its motion is direct. If it ſhould come to its perihelium on *January* 1, 1789, it might be ſeen in the ſouthern parts of the world with a good achromatic teleſcope about the middle of *September*, towards the middle of *Piſces*, with 55° ſouth latitude, and 53 ſouth declination."

Sir Iſaac Newton obſerves, that as the great eccentricity of the orbits of comets renders them very liable to be diſturbed by the attraction of the planets and other comets, it is probably, to prevent too great diſturbances from theſe, that while all the planets revolve nearly in the ſame plane, the comets are diſpoſed in very different ones, and diſpoſed all over the heavens; that when in their greateſt diſtance from the ſun, and moving ſloweſt, they might be removed as far as poſſible out of the reach of each other's action. The ſame end is likewiſe anſwered in theſe comets, which by moving ſloweſt in the aphelion or remoteſt diſtance from the ſun, deſcend neareſt to it by placing their aphelion at the greateſt height from the ſun. See more on the ſubject of comets by Sir Iſaac, Sect. III. n° 169.

§ 5. *Of the Bodies of the Sun and Planets, with the Method of computing the Quantity of Matter they contain.*

Our author having proved, as has been related, that the primary planets and comets are retained in their orbits by a power directed towards the ſun, and that the ſecondaries are alſo retained by a power of the like kind directed to the centre of their primaries, 302

Attractive power diffuſed throughout the ſubſtance of all matter.

proceeds next to demonſtrate, that the ſame power is diffuſed through their whole ſubſtance and inherent in every particle. For this purpoſe he ſhows firſt, that each of the heavenly bodies attracts the reſt and other bodies with ſuch different degrees of force, as that the force of the ſame attracting body is exerted on others exactly in proportion to the quantity of matter contained in the body attracted. The firſt proof of this he brings from experiments made on bodies here on

earth

Of the Bodies of the Sun and Planets.

earth. The power by which the moon is influenced has been already shown to be the same with that which we call *gravity*. Now, one of the effects of the principle of gravity is, that all bodies descend by this force from equal heights in equal times. This was taken notice of long ago; and particular methods have been invented to show, that the only cause why some bodies were observed to fall in a shorter time than others was the resistance of the air. As these methods, however, have been found liable to some uncertainty, Sir Isaac Newton had recourse to experiments made on pendulums. These vibrate by the same power which makes heavy bodies fall to the ground; but if the ball of any pendulum of the same length with another were more or less attracted in proportion to the quantity of solid matter it contains, that pendulum must then vibrate faster or slower than the other. Now the vibrations of pendulums continue for a long time, and the number of vibrations they make may be easily determined without any suspicion of error; so that this experiment may be extended to what exactness we please: and Sir Isaac assures us, that he examined in this way several substances, as gold, silver, lead, glass, sand, common salt, wood, water, and wheat; in all which he found not the least deviation from the theory, tho' he made the experiment in such a manner, that in bodies of the same weight, a difference in the quantity of their matter less than the thousandth part of the whole would have discovered itself. It appears, therefore, that all bodies are made to descend here by the power of gravity with the same degree of swiftness. This descent has already been determined at $16\frac{1}{8}$ feet in a second from the beginning of their fall. It has also been observed, that if any terrestrial body could be conveyed as high up as the moon, it would descend with the very same degree of velocity with which the moon is attracted toward the earth; and therefore that the power of the earth upon the moon bears the same proportion it would have upon those bodies at the same distance as the quantity of matter in the moon bears to the quantity in those bodies. Thus the assertion is proved in the earth, that its power on every body it attracts is, at the same distance from the earth, proportional to the quantity of solid matter in the body acted upon. As to the sun, it has been shown, that the power of his action upon the same primary planet is reciprocally in the duplicate proportion of its distance; and that the power of the sun decreases throughout in the same proportion, is testified by the motion of the planets traversing the whole planetary region. This proves, that if any planet were removed from the sun to any distance whatever, the degree of its acceleration towards the sun would yet be reciprocally in the duplicate proportion of their distance. But it has already been proved, that the degree of acceleration given to the planets by the sun is reciprocally in the duplicate proportion of their respective distances; all which compared together, puts it out of doubt, that the power of the sun upon any planet removed into the place of any other, would give it the same velocity of descent as it gives that other; and consequently that the sun's action upon different planets at the same distance would be proportionable to the quantity of matter in each. It has likewise been shown, that the sun attracts the primary planets and their respective secondaries, when at the same distance, in such a manner as to communicate to both the same degree of velocity; and therefore the force wherewith the sun acts on the secondary planet bears the same proportion to the force wherewith it attracts the primary, as the quantity of matter in the secondary planet bears to the quantity of matter in the primary. This property therefore is found in the sun with regard to both kinds of planets; so that he possesses the same quality found in the earth, viz. that of acting on bodies with a degree of force proportional to the quantity of matter they contain.

303 Properties of gravity demonstrated by pendulums.

304 Attraction proportioned to the quantity of matter

This point being granted, it is hardly to be supposed that the power of attraction with which the other planets are endowed, should be different fom that of the earth, if we consider the similitude of these bodies: and that it does not in this respect, is farther evident from the satellites of Saturn and Jupiter which are attracted according to this law; that is, in the same proportion to their distances that their primaries are attracted by the sun. So that what has been concluded of the sun in relation to the primary planets may be justly concluded of those primaries in respect to their secondaries; and in consequence of that likewise in regard to all other bodies, viz. that they will attract every other body in proportion to the quantity of solid matter it contains. Hence it follows, that this attraction extends itself to every particle of matter in the attracted body, and that no proportion of matter is exempted from the influence of these bodies to which this attractive power has been proved to belong.

305 Attraction acts equally throughout the bodies in the universe.

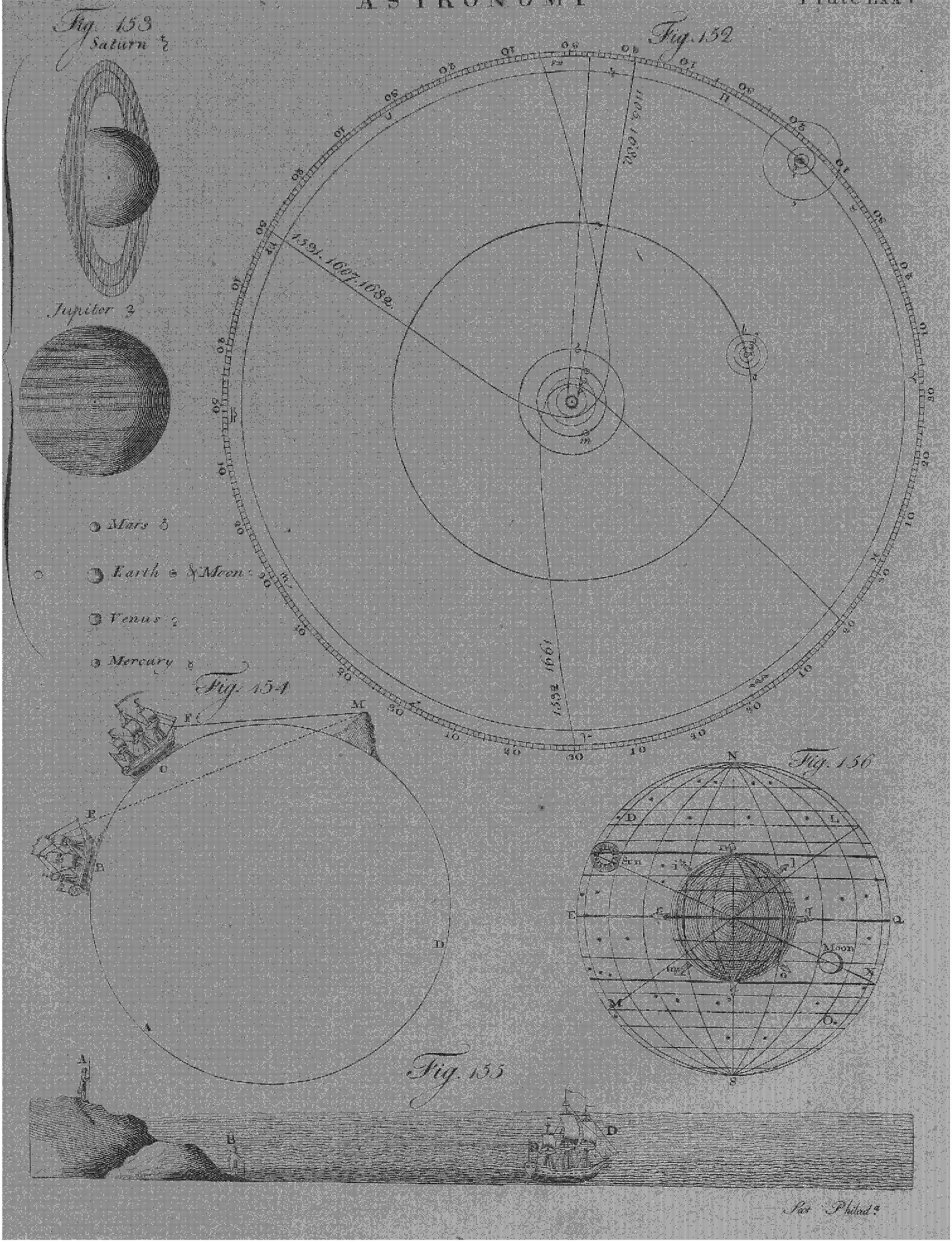
Here we may remark, that the attractive power both of the sun and planets appears to be the same in all; for it acts in each in the same proportion to the distance, and in the same manner acts alike upon every particle of matter. This power, therefore, in the sun and planets, is not of a different nature from the power of gravity in the earth: and this enables us to prove, that the attracting power lodged in the sun and planets belongs likewise to every part of them; and that their respective powers upon the same body are proportional to the quantity of matter of which they are composed; for instance, that the force with which the earth attracts the moon, is to the force with which the sun would attract it at the same distance, as the quantity of solid matter in the earth is to that in the sun.

Before we proceed to a full proof of these assertions, it will be necessary to show that the third law of motion, viz. That action is equal to reaction, holds good in attractive powers as well as in any other. The most remarkable force of this kind with which we are acquainted, next to that of gravity, is the attraction the loadstone has for iron. Now if a loadstone and piece of iron were both made to swim on water, both of them would move towards each other, and thus the attraction would be shown to be mutual; and when they meet, they will mutually stop each other: which shows that their velocities are reciprocally proportioned to the quantities of solid matter in each; and that by the stone's attracting the iron, it receives as much motion itself, in the strict philosophic sense of the word, as it communicates to the iron: for it is proved from experiments on the percussion of bodies, that if two meet with velocities reciprocally proportional to the respective bodies, they will be stopt by the concourse, unless they meet with some other velocity, or their elasticity

2

ASTRONOMY

Plate LXXV



Of the Bodies of the Sun and Planets.

city put them into freſh motion. Hitherto, however, for the ſake of brevity, in ſpeaking of theſe forces, we have aſcribed them to the body which is leaſt moved; as when we called the power which exerts itſelf between the ſun and planets, *the attractive power of the ſun:* but to ſpeak more correctly, we ſhould rather call this power in any caſe the force which acts between the ſun and earth, between the earth and moon, &c. for both the bodies are moved by the power acting between them, in the ſame manner as when two bodies are tied together by a rope, if that ſhould ſhrink by being wet or otherwiſe, and thereby cauſe the bodies to approach; by drawing both, it will communicate to

306 Why the ſun and planets revolve about their common centre of gravity.

both the ſame degree of motion, and cauſe them to approach each other with velocities proportional to their quantities of matter. From this mutual action of the ſun and planets upon each other, it follows, as has been already mentioned, that they both revolve about their common centre of gravity. Thus let A (in fig. 136.) repreſent the ſun, B, a planet and C their common centre of gravity. If theſe bodies were once at reſt, they would directly approach each other by their mutual attraction, and that with ſuch velocities, that their common centre of gravity would remain at reſt, and they would meet in that point. Were the planet B to receive an impulſe, as in the direction DE, this would prevent the two bodies from falling together; but their common centre of gravity would be put into motion in the direction of the line CF, equidiſtant from BE. In this caſe Sir Iſaac Newton proves, that the ſun and planet would deſcribe round their common centre of gravity ſimilar orbits, while that centre would proceed with an uniform velocity in the line CF, and ſo the ſyſtem of the two bodies would move on with the centre of gravity without end. In order to keep the ſyſtem in the ſame place, it is neceſſary, that when the planet received its impulſe in the direction BE, the ſun ſhould receive ſuch another the contrary way, ſo as to keep the centre of gravity C without any motion, in which caſe it would always remain fixed.

Thus we may underſtand in what manner the action between the ſun and planets is mutual. It has alſo been ſhown, that the power which acts between the ſun and primary planets is altogether of the ſame nature with that which acts between the ſecondary planets and their primaries, or which acts between the earth and bodies near its ſurface. It has alſo been already proved, that in different planets the force of the ſun's action upon each at the ſame diſtance would be proportional to the quantity of ſolid matter contained in the planet: therefore the reaction of the planet on the ſun at the ſame diſtance, or the motion which he would receive from each planet, would alſo be proportional to the quantity of matter in the planet; that is, theſe planets, at the ſame diſtance, would act on the ſame body with degrees of ſtrength proportioned to the quantity of ſolid matter contained in each.

307 The ſmalleſt particles of matter attract each other according to the ſame law.

In the next place, our author deduces from the principles above demonſtrated, that each of the particles out of which the ſun, moon, and planets, are formed, exert their power of gravitation by the ſame law, and in the ſame proportion to the diſtance, as the great bodies they compoſe. For this purpoſe, he firſt demonſtrates, that if a globe were compounded of particles which will attract the particles of any other body reciprocally in the duplicate proportion of their diſtances, the whole globe will attract the ſame in the reciprocal duplicate proportion of their diſtances from the centre of the globe, provided it be of equal denſity throughout. Hence alſo he deduces the reverſe; that if a globe acts upon diſtant bodies by the law juſt now ſpecified, and the power of the globe be derived from its being compoſed of attracting particles, each of theſe will attract after the ſame proportion. The manner of deducing this is as follows: The globe is ſuppoſed to act upon the particles of a body without it conſtantly in the reciprocal duplicate proportion of their diſtances from the centre; and therefore, at the ſame diſtance from the globe, on which ſide ſoever the body be placed, the globe will act equally upon it. Now, becauſe if the particles of which the globe is compoſed acted upon thoſe without in the reciprocal duplicate proportion of their diſtances, the whole globe would act upon them in the ſame manner as it does; therefore, if the particles of the globe have not all of them that property, ſome muſt act ſtronger than in that proportion, whilſt others act weaker: and if this be the condition of the globe, it is plain, that when the body attracted is in ſuch a ſituation in reſpect of the globe that the greater number of the ſtrongeſt particles are neareſt to it, the body will be more forcibly attracted than when, by turning the globe about, the greater quantity of weak particles would be neareſt, though the diſtance of the body ſhould remain the ſame from the centre of the globe; which is contrary to what was at firſt remarked, that the globe acts equally on all ſides.

It is farther deduced from theſe propoſitions, that if all the particles of one globe attract all the particles of another in the proportion already mentioned, the attracting globe will act upon the other in the ſame proportion to the diſtance between the centre of the globe which attracts and the centre of that which is attracted: and farther, that the proportion holds true, though either or both of the globes be compoſed of diſſimilar parts, ſome rarer, and ſome more denſe; provided only, that all the parts in the ſame globe, equally diſtant from the centre, be homogeneous, and likewiſe if both globes attract each other.

308 Attraction an univerſal property of matter.

Thus has our author ſhown that this power in the great bodies of the univerſe is derived from the ſame being lodged in every particle of the matter which compoſes them; and conſequently that it is no leſs than univerſal in matter, though the power be too minute to produce any viſible effects on the ſmall bodies with which we are converſant by their action on one another. In the fixed ſtars indeed we have no particular proof that they have this power, as we find no appearance to demonſtrate that they either act or are acted upon by it. But ſince this power is found to belong to all bodies whereon we can make obſervation, and we find that it is not to be altered by any change in the ſhape of bodies, but accompanies them in every form, without diminution, remaining ever proportional to the quantity of ſolid matter in each; ſuch a power muſt without doubt univerſally belong to matter.

Of the Bodies of the Sun and Planets.

All this naturally follows from a consideration of the phenomena of those planets which have secondaries revolving about them. By the times in which these satellites perform their revolutions, compared with

309 How to determine the power of gravity on any of the planets.

their distances from their respective primaries, the proportion between the power with which one primary attracts his satellites and the force with which any other attracts his will be known; and the proportion of the power with which any planet attracts his secondary to the power with which it attracts a body at its surface, is found by comparing the distance of the secondary planet from the centre of the primary to the distance of the primary planet's surface from the same: and from hence is deduced the proportion between the power of gravity upon the surface of one planet to the gravity upon the surface of another. By the like method of comparing the periodical time of a primary planet about the sun with the revolution of a satellite about its primary, may be found the proportion of gravity or of the weight of any body on the surface of the sun, to the gravity or to the weight of the same body upon the surface of the planet which carries about the satellite. By computations of this kind it is found, that the weight of any body on the surface of the sun will be about 23 times as great as on the surface of the earth; about 10 times as great as on the surface of Jupiter; and near 19 times as great as on Saturn. The quantity of matter contained in each of these bodies is proportional to the power it has upon a body at a given distance. Thus it is found, that the sun contains 1067 times as much matter as Jupiter; Jupiter $158\frac{1}{3}$ times as the earth, and $2\frac{1}{3}$ times as much as Saturn. The diameter of the sun, according to the data with which Sir Isaac Newton was furnished, was calculated at 92 times, that of Jupiter about 9 times, and that of Saturn about 7 times as large as the diameter of the earth.

310 Densities of the heavenly bodies.

By comparing the quantities of matter in each of these bodies with their respective magnitudes their densities are likewise easily discovered; the density of every body being measured by the quantity of matter contained under the same bulk. Thus the earth is found $4\frac{1}{4}$ times more dense than Jupiter, while Saturn has only between two-thirds and three-fourths of the density of the latter, and the sun has only one-fourth part of the density of the earth. From all this our author draws the following conclusions, viz. That the sun is rarefied by its great heat; and of the three planets above-mentioned, the most dense is that nearest the sun. This it was highly reasonable to expect, the densest bodies requiring the greatest heat to agitate and keep their parts in motion; as on the contrary, the planets which are more rare would be rendered unfit for their office by the intense heat to which the denser are exposed. Thus the waters of our seas, if removed to the distance of Saturn would remain perpetually frozen, and at Mercury would constantly boil. The densities of the planets Mars, Venus, Mercury, and the *Georgium Sidus*, as they are not attended with planets on which many observations have been made, cannot be ascertained. From analogy, however, we ought to conclude, that the inferior planets, Venus and Mercury are more dense than the earth, Mars more rare, and the Georgium Sidus much more rare, than any of the rest.

SECT. V. *The Newtonian Doctrine applied more particularly to the Explication of the Celestial Phenomena.*

Particular Explication of the Celestial Phenomena.

FROM the general account of those laws by which the universe is upheld, we now proceed to give an explanation of the particular parts of which it is composed. Those which are most exposed to our researches, besides the Earth we inhabit, are the Sun, Moon, Mercury, Venus, Mars, Jupiter, Saturn, and the Georgium Sidus (see fig. 119.). The sun, an immense globe of fire, is situated near the centre of the system, round which he turns by a small and irregular motion, according as the common centre of gravity betwixt him and the planets, which is the true centre of the system, varies by their different positions on this or that side of him. All the planets move round this common centre of gravity together with the sun; but the latter, by reason of his vast bulk, is so near the true centre, that the motions of the celestial bodies are by astronomers always referred to the centre of the sun as the point round which they are directed. The motions of all of them are performed the same way, viz. from west to east; and some comets have been observed to move also in this way, though the motion of others has been directly contrary. This motion, from west to east, is said to be in the order of the signs, or *in consequence*, as has been already mentioned, with regard to the moon; while that from east to west is in *antecedence*, or contrary to the order of the signs. Though all of them, however, revolve round the sun, their motions, as we have already observed, are not in the same plane, but inclined to one another by small angles: and the way in which we compute this inclination is by considering the orbit of the earth as a standard, and calculating the angle which each of their orbits makes with it.

311 Heliocentric circles of the planets.

To a spectator placed in the sun, all the planets would appear to describe circles annually in the heavens; for though their motions are really elliptical, the eccentricity is so small, that the difference between them and true circles is not easily perceived even on earth; and at the sun, whether great or small, it would entirely vanish. These circles, which in such a situation would appear to be annually described among the fixed stars are called the *heliocentric circles* of the planets; and if we suppose the orbits of the planets to be extended to the extreme bounds of the creation, they would describe among the fixed stars those circles just mentioned. To a spectator in the sun, the comets, though moving in the most eccentric orbits, would also appear to describe circles in the heavens; for though their orbits are in reality very long ellipses, the planes of them extended to the heavens would mark a great circle thereon, whereof the eye would be the centre; only, as the real motion is in an ellipsis, the body would appear to move much more slowly in some part of the circle than another, and to differ excessively in magnitude. To an inhabitant of any planet, however, the sun appears to go round in its own heliocentric circle, or to describe in the heavens that same curve which the planet would appear to do if seen from the sun. Thus (fig. 137), when the earth is at *a*, if we

Fig. 158.

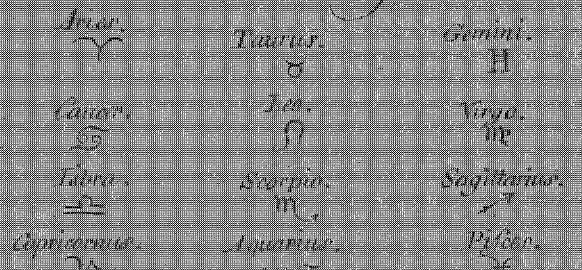


Fig. 159.

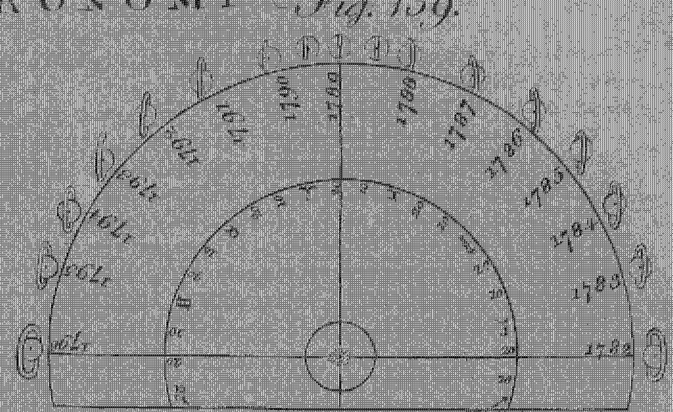


Fig. 160.

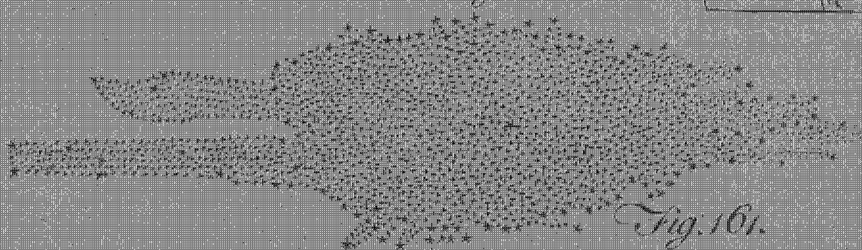
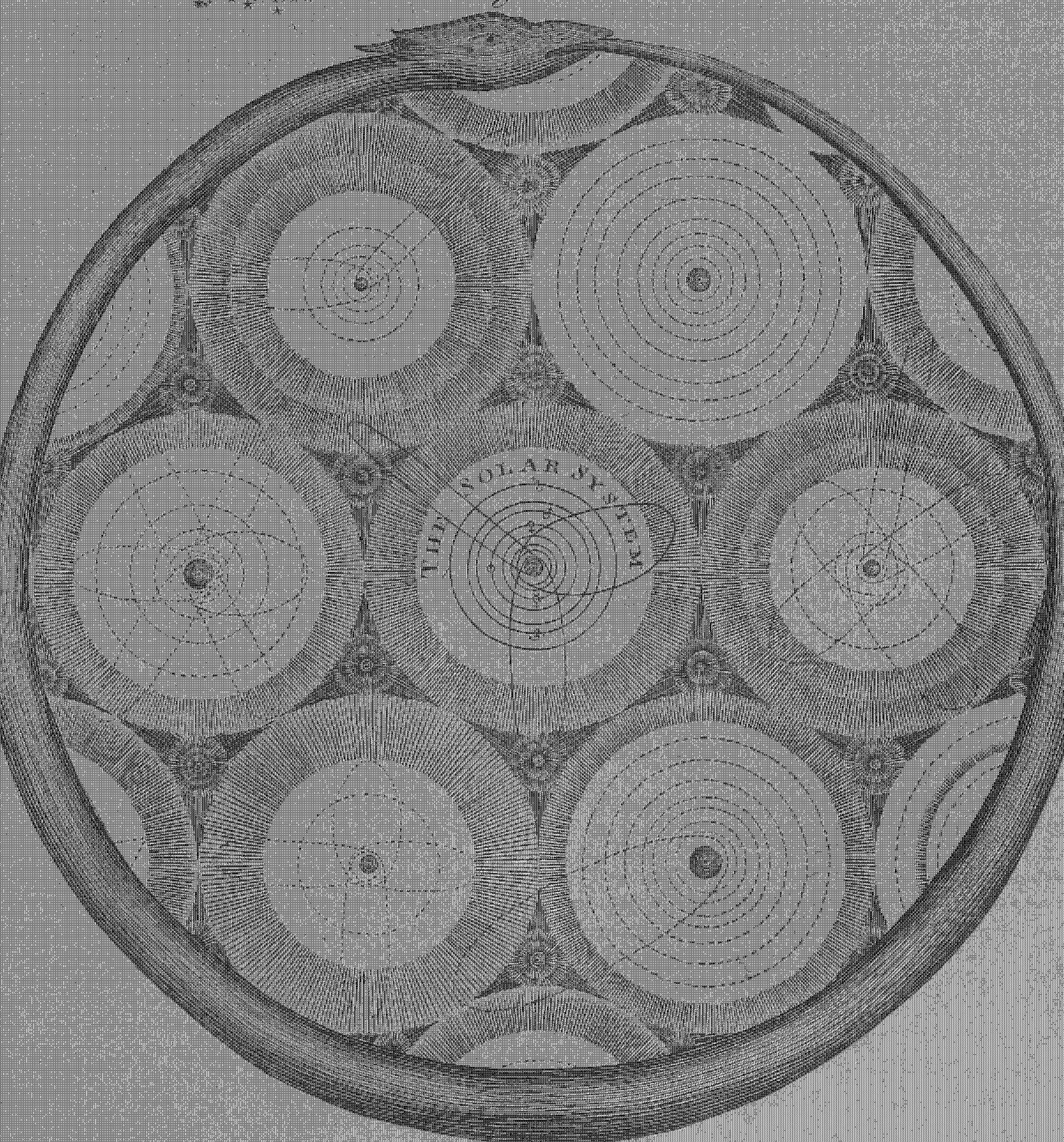


Fig. 161.



we draw a line from *a* through the ſun at S, the point G, in the ſphere of the heavens where the line terminates, is the place where the ſun then appears to an inhabitant of the earth. In a month's time the earth will be got from *a* to *b*; draw a line then through the ſun, and its extremity at H will point out his apparent place at that time. In like manner, if we draw lines from the earth in the twelve ſeveral ſituations in which it is repreſented for the twelve months of the year, the ſun's apparent place will be found as above, and ſo it would be found by a ſpectator placed in Venus or any other planet.

312 Ecliptic, why ſo named.

The heliocentric circle of the earth is called the *ecliptic;* becauſe eclipſes of the ſun or moon can only happen when the latter is in or near it, as will afterwards be more particularly explained. By ſome ancient writers it has been called the circle of the ſun, or the oblique circle, becauſe it cuts the equator at oblique angles. It is alſo called by Ptolemy the circle which paſſes through the midſt of the animals; becauſe the twelve conſtellations through which it paſſes were anciently all repreſented by animals, or parts of them, though now the *balance* is introduced in place of the claws of the *ſcorpion*.

313 Zodiac.

For this reaſon, a belt or hoop taken in the concave ſphere of the heavens about 10 degrees on each ſide of the ecliptic, is called the *zodiac*, from a Greek word which ſignifies an animal; and the conſtellations through which the ecliptic is drawn, are called the conſtellations of the zodiac.

314 How to determine the ſun's place.

Though the ſun, as we have ſaid, apparently goes round the earth annually in the circle juſt mentioned, we cannot determine his place by mere inſpection as we can do that of any of the other heavenly bodies; for the fixed ſtars are the only marks by which we can determine the places of any of the celeſtial bodies, and the ſuperior brightneſs of the ſun renders them totally inviſible except in the time of a great eclipſe when his light is for a time totally obſcured. But though we cannot know the place of the ſun directly, it is eaſily found from a knowledge of thoſe fixed ſtars which are oppoſite to him. Thus, in fig. 137. ſuppoſe it the time of the year in which the earth it at *g*, if we know that the point G is then diametrically oppoſite to the ſun, we know that A, its oppoſite, is the ſun's place; and conſequently, by finding the places throughout the year diametrically oppoſite to the ſun, as GHIKLM ABCDEF, we may be aſſured that in theſe times the ſun's place was in the points ABCDEFGHIKLM. The point in the heavens diametrically oppoſite to the ſun may be known every night at twelve o'clock when the ſtars are viſible; for the ſtar which has an elevation above the horizon at that time equal to the ſun's depreſſion below it, is directly oppoſite to him.

315 Latitude, declination, &c. explained.

The ecliptic being thus found, the latitude of the moon or any ſtar is counted by its diſtance from the ecliptic, as the latitude of places on earth is counted by their diſtance from the equator; and is marked upon circles drawn through the pole of the ecliptic, and perpendicular to its plane, as the latitude of places is marked on one of the meridians of a terreſtrial globe. Theſe are called *circles of latitude*, and each of them is ſuppoſed to divide the celeſtial concave into two equal hemiſpheres; and the *declination* of any celeſtial body is its deviation from the ecliptic towards the celeſtial equator perpendicular to that of the earth.

The latitude of any planet is either heliocentric or geocentric. The heliocentric latitude is its diſtance from the ecliptic as ſeen from the ſun, and its geocentric as ſeen from the earth, and is conſiderably different from the former. With the fixed ſtars indeed it is otherwiſe; for their diſtance is ſo vaſt, that the whole diameter of the earth's orbit is but a point in compariſon with it. For this reaſon, whatever part of its orbit the earth may be in, the fixed ſtars always appear to keep the ſame place; but with reſpect to the planets, the orbit of the earth, or *magnus orbis*, as it has ſometimes been called, bears a very conſiderable proportion, excepting only to the Georgium Sidus, of whoſe diſtance the diameter of the earth's orbit forms little more than a tenth part; and therefore all calculations with regard to that ſtar are much more difficult than the reſt. The apparent places of the planets therefore are conſiderably altered by the earth's change of place as well as by their own motions; ſo that though a planet ſhould ſtand ſtill for a whole year, it would nevertheleſs appear to us to deſcribe a circle round the heavens, as in that ſpace of time we would have been carried by the earth round the ſun, and have continually taken a view of it from different ſtations. As the orbits of the planets are inclined in different angles to the ecliptic, it thence happens, that the heliocentric latitude of any planet is almoſt always different from its geocentric latitude. Thus, let AB, fig. 138. be the orbit of the earth, CD the orbit of Venus, viewed with the eye in their common ſection, wherein they appear ſtraight lines; let E and F be two oppoſite points of the ecliptic; and ſuppoſe Venus to be in the point C in her utmoſt north limit. If ſhe were at that time viewed from the ſun S, ſhe would appear in the point of the heavens marked H, and her heliocentric latitude is then FH: but if viewed from the earth in B, ſhe will appear at *g*; at which time her heliocentric latitude is FH, and her geocentric only F*g*. When at I, her apparent place is at K, her heliocentric latitude FH, and her geocentric FK; but when the earth is at A, her apparent place will then be at G, and her geocentric latitude EG, while her heliocentric is only FH as before.

316 How to find the geocentric latitude of a ſuperior planet.

The two planets, Mercury and Venus, whoſe orbits are included in that of the earth, are called *inferior;* and Mars, Jupiter, Saturn, and the Georgium Sidus, whoſe orbits include that of the earth, are called *ſuperior;* and from the circumſtance juſt mentioned, they muſt preſent very different appearances in the heavens, as will afterwards be particularly explained. The geocentric latitude of a ſuperior planet may be underſtood from fig. 139. Let AB be the orbit of the earth, CD that of Mars, both viewed with the eye in their common ſection continued, by which they appear in ſtraight lines. Let E and F be oppoſite points of the ecliptic, and ſuppoſe Mars to be in his ſouth limit at C. If he were at that time viewed from S, the centre of the ſun, he would appear in the ſphere of the heaven at the point H; in which caſe his heliocentric latitude would be FH: But when viewed in C from the earth, or from its centre, which in this caſe is ſuppoſed to be the ſtation of the ſpectator, he will appear to be in different places of the heavens according to the poſition of the

the earth. When the earth, for instance, is at B, the place of Mars will appear to be at *g*, and his geocentric latitude will be F *g*. When the earth is at A, his apparent place will be in G, and his geocentric latitude FG: and in like manner, supposing the earth to be in any other part of its orbit, as in I or K, it is easy to see, that his apparent places, as well as geocentric latitudes at those times, will be different.

317 Nodes of a planet.

The two points where the heliocentric circle of any planet cuts the ecliptic are called its *nodes*: and that which the planet passes through as it goes into north latitude, is called the *ascending* node, and is marked thus ☊; and the opposite to this is called the *descending* node, and is marked ☋. A line drawn from one node to the other is called the *line of the nodes of the planet*, which is the common section of the plane of the ecliptic, and that of the planet produced on each side to the fixed stars.

318 Zodiac and signs explained.

The zodiac, of which we have already given some account, is either *astral* or *local*. The astral is divided into 12 unequal parts, because it contains 12 celestial constellations, some of which are larger than others. This continues always invariably the same; because the same stars now go to the making up of the different constellations as formerly, excepting some small variations to be afterwards explained. The local zodiac is divided into twelve equal parts, each containing 30 degrees, called *signs*. These are counted from the point where the equator and ecliptic intersect each other at the time of the vernal equinox; and are denoted by particular marks, according to the apparent annual motion of the sun. See fig. 158. A motion in the heavens in the order of these signs, as from Aries to Taurus, is said to be a motion *in consequence*; and such are the true motions of all the planets; tho' their apparent motions are sometimes contrary, and then they are said to move in *antecedence*. The local zodiac is not always invariably the same as to the places of the several signs, though the whole always takes up the same place in the heaven, viz. 10 degrees on each side the ecliptic. The points where the celestial equator cuts into the ecliptic are found to have a motion in antecedence of about 50 seconds in a year. This change of place of the first point of the ecliptic, from whence the signs are counted, occasions a like change in the signs themselves; which though scarce sensible for a few years, has now become very considerable. Thus, since astronomy was first cultivated among the Greeks, which is about 2000 years ago, the first point of the ecliptic is removed backward above a whole sign; and though it was then about the middle of the constellation Aries, is now about the middle of Pisces. Notwithstanding this alteration, however, the signs still retain their ancient names and marks. When the zodiac is mentioned by astronomers, the local zodiac is generally meant.

319 Longitude of celestial bodies explained.

The longitude of a phenomenon in the heavens is the number of degrees counted from the first point of Aries on the ecliptic to the place where a circle of latitude drawn through the phenomenon would cut the ecliptic at right angles. Every phenomenon in the heavens, whether in the zodiac or not, is thus referred to the ecliptic by the circles of latitude, as the longitudes of terrestrial places are referred to the equator by the meridians; and whatever sign the circle of latitude passes through, the phenomenon is said to have its place in that sign, though ever so far distant from it.

Some astronomical writers have made the local zodiac invariable: for which purpose they imagine a circle of latitude drawn through the first star of the constellation Aries, marked in Bayer's catalogue by the Greek letter γ; and reckon their longitude from the point where that circle cuts the ecliptic. This star, from its use, is called the first star of the Ram; and when this method is made use of, the longitude of any phenomenon is said to be so many signs, degrees, minutes, &c. from the first star of the Ram. Thus, in Street's Caroline tables, the longitude of Jupiter's ascending node is two signs eight degrees from the first star of Aries, which is thus marked: Long. ♃ ☊ à 1 ✱ ♈ 2s 8°. The common way of reckoning the longitude of a phenemenon is to take ♈ for the first point of the ecliptic, and not to number the degrees quite round that circle as a continued series, but to make a new beginning at the first point of every sign, and to reckon from thence only the length of 30°. When this method is made use of, the longitude of any phenomenon is expressed, by saying it is in such a degree and such a minute of a sign: and thus we may express the longitude of the ascending node of Mercury, ☿ ☊ ♉ 14° 40′; and so of any other. The place of a phenomenon in the heaven is expressed by setting down its longitude and latitude as is done with places situated any where on the surface of the earth.

Having thus explained the astronomical terms commonly made use of with respect to the planets; and likewise shown how from their motions and that of the earth, there must be a considerable variation in their apparent places, as seen from the sun and from the earth; we shall now proceed to a more particular consideration of their phenomena, as derived from a composition of the two motions just mentioned, viz. that of the planets in their respective orbits, and that of the earth in the ecliptic. Every planet, like the moon, is sometimes in conjunction and sometimes in opposition with the sun. Its conjunction is when the geocentric place of the planet is the same with that of the sun; though an exact or central conjunction can only take place when the line of its nodes passes through the earth, and the planet itself is in one of its nodes at the time. It is however, in general, called a conjunction, or opposition, when the same circle of latitude passes through the sun and planet at the same time. When the geocentric place of a planet is 90°, or a quarter of a circle from the sun's place, the planet is said to be in *quadrature*, or in *quartile* aspect with the sun; and these terms are used in a like sense when applied to any two of the heavenly bodies. Thus the sun and moon, or the moon and any planet, or any two planets, may be in conjunction, opposition, or quadrature. Besides these, the ancients reckoned other two aspects, the *trine* and the *sextile*; the former when the bodies were distant 120°, and the latter when only half that distance. These aspects they marked thus:

320 Conjunctions and oppositions of the planets explained.

221 Aspects of the planets.

Conjunction.	Opposition.	Quadrature.	Trine.	Sextile.
☌	☍	□	△	✱

The aspects were supposed to influence the affairs of mankind; and many conclusions drawn from them too absurd to be mentioned here, and now indeed almost entirely buried in oblivion.

The

Particular Explication of the Celestial Phenomena.

The inferior planets have two kinds of conjunction with the sun; one in the inferior part of their semicircles, where they are nearer to the earth than the sun; the other in the superior part, where they are farther off. In the former, the planet is between the earth and the sun; and in the latter, the sun is between the earth and planet. The inferior planets can never be in opposition to the sun, nor even appear at a great distance from him. The length they go is called their *elongation*. Thus, in fig. 140. let OPQRT be part of the ecliptic; S the sun; and the three circles round him, the orbits of Mercury, Venus, and the Earth.

322 Geocentric places, &c. of the inferior planets

Suppose the earth to be at A, the sun's geocentric place will be at Q. If Mercury be then at I, his geocentric place is likewise at Q; so that he is in conjunction with the sun in his inferior semicircle: if at M, his geocentric place is likewise at Q; so that he is in conjunction in his superior semicircle. In like manner, Venus at E is in conjunction in her inferior semicircle, at G in her superior: but if we suppose the earth to be at A, and Venus at H, her geocentric place is T, and her elongation QT, which in this figure is the greatest possible; for this always takes place when a straight line from the earth touches the orbit of the planet, as is evident from the figure; that is, provided the planet be in its aphelion at the time. Thus the greatest possible elongation of Mercury is QP when he is in his aphelion at L; and the quantity of this is found by astronomical observations to be about 28 degrees, that of Venus about 48. The inferior planets in their elongations are sometimes eastward and sometimes westward of the sun: in the former case they appear in the evening, and in the latter in the morning. The smallness of Mercury and his nearness to the sun prevent him from being often taken notice of; but the largeness and beauty of Venus have made her, in all ages, celebrated as the *evening* and *morning star*.

323 Direct retrograde motions of the planets explained.

The irregular apparent motion of the planets has been already taken notice of; sometimes going forward, sometimes backward, and sometimes appearing to stand still for a little. These different conditions are by astronomers called *direct*, *retrograde*, and *stationary*. Were they to be viewed from the sun, they would always appear direct, as has been already shown; but when viewed from the earth, the inferior planets appear direct when moving in their upper semicircle, and retrograde when in their lower ones. Thus, in fig. 140. suppose the earth at rest at A, while Mercury is going on in his orbit from N to I. from I to L his motion appears to an observer at A to be retrograde, or contrary to the order of the signs, namely, from R to Q and from Q to P; but when in that part of his orbit which lies between L and N, his motion appears direct, or from P to Q and from Q to R.

When the earth is in the line of nodes of an inferior planet, the apparent motion of the former is then in a straight line, because the plane of it passes through the eye; if in a conjunction in his upper semicircle, he passes behind the sun; if in his lower semicircle, he passes before it, and will then be seen by an observer on earth to pass over the sun's disk like a round and very black spot. Were the plane of his orbit coincident with the ecliptic, this appearance would be seen every year; but by reason of the obliquity of the two planes to each other, it is much more rare. However, he was seen in this manner November 12th 1782, at 3 h. 44′ in the afternoon; May 4th 1786, at 6 h. 57′ in the morning; and will be seen again December 6th 1789, at 3 h. 55′ in the afternoon: but from that time not, in Britain at least, until the year 1799, May 7th, at 2 h. 34′ in the afternoon. In like manner, Venus sometimes appears as a black spot on the sun, but much more seldom than Mercury. She was first seen by Mr Horrox, as we have already related, in the year 1639; afterwards in the years 1761 and 1769; but will not afterwards be visible in this manner till the year 1874.

When the earth is out of the line of the nodes of an inferior planet, its orbit appears an ellipsis, more or less eccentric according to the situation of the eye of the spectator. Thus, suppose the earth to be as far as possible (that is 90°) out of the line of the nodes of Mercury, the projection of his orbit will be in such an elliptic curve as is represented fig. 141. wherein he will appear to move in the order of the letters; direct when in his upper semicircle from *a* to *b*, from *b* to *c*, being above the sun at *b* in his superior conjunction: but in his inferior semicircle his motion will appear retrograde from *c* to *d*, and from *d* to *a*; in conjunction he will be at *d* below the sun. In these cases, the motion of Mercury is unequal; faster near the inferior conjunction, but most unequal in the inferior semicircle, going through the unequal spaces into which the ellipsis is divided. The motions of the inferior planets, both direct and retrograde, are very unequal: and this inequality proceeds not from the eccentricity of their orbits, but from the projection of their orbits into long ellipsis; and is therefore a mere optical deception.

These planets appear stationary while changing their motion from direct to retrograde, or from retrograde to direct. If the earth stood still, the times of their appearing stationary would be at their greatest elongation; for though it be a property of the circle that a straight line can only touch it in one point, yet when the circle is very large the recess from the tangent is not perceptible for a considerable time. Thus, in fig. 140. suppose the earth to be at rest in A, Venus would appear stationary, her geocentric place continuing at T all the while she is going in her orbit from *a* to *b*; because her deviation from the visual line AT would scarce be perceptible so near the point of contact H.

To an inhabitant of the earth, therefore, the inferior planets appear always near the sun; alternately going from and returning to him, sometimes in straight lines, at others in elliptical curves, first on one side and then on the other; sometimes so near as to be rendered invisible by his stronger light. Sometimes, when in or near their nodes, they pass behind the sun in their superior semicircles, or pass between him and us; in which case they appear like black spots on his disk, as has been just now mentioned. For the better comprehending of these motions, however, we have hitherto supposed the earth to stand still in some part of its orbit, while they go round the sun in theirs; but as this is not the case, it now remains to consider the changes which take place in consequence of the earth's motion. Were the earth to stand still in any part of her

324 Effects of the earth's motion on the appearances of the planets.

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her orbit as at A, the places of conjunction both in the superior and inferior semicircle, as also of the greatest elongation; and consequently the places of direct and retrograde motion, and of the stations of an inferior planet, would always be in the same part of the heavens. Thus, in fig. 140. upon this supposition, the places of Mercury's stations would always be the points P and R, the arc of his motion PR, and of his retrograde motion RP; whereas, on account of the earth's motion, the places where these appearances happen are continually advancing forward in the ecliptic according to the order of the signs. In fig. 142, let ABCD be the orbit of the earth; *e f g h* that of Mercury; ⊙ the sun; GKI an arc of the ecliptic extended to the fixed stars. When the earth is at A, the sun's geocentric place is at F; and Mercury, in order to a conjunction, must be in the line AF; that is, in his orbit he must be at *f* or *h*. Suppose him to be at *f* in his inferior semicircle: If the earth stood still at A, his next conjunction would be when he is in his superior semicircle at *h*; the places of his greatest elongation also would be at *e* and *g*, and in the ecliptic at E and G: but supposing the earth to go on in its orbit from A to B; the sun's geocentric place is now at K; and Mercury, in order to be in conjunction, ought to be in the line BK at *m*. As by the motion of the earth the places of Mercury's conjunction with the sun are thus continually carried round in the ecliptic in consequence, so the places of his utmost elongations must be carried in consequence also. Thus, when the earth is at A, the places of his greatest elongation from the sun are in the ecliptic E and G; the motion of the earth from A to B advances them forward from G to L and from E to I. But the geocentric motion of Mercury will best be seen in fig. 146. Here we have part of the extended ecliptic marked ♈, ♉, ♊, &c. in the center of which S represents the sun, and round him are the orbits of Mercury and the earth. The orbit of Mercury is divided into 11 equal parts, such as he goes through once in eight days; and the divisions are marked by numeral figures 1, 2, 3, &c. Part of the orbit of the earth is likewise divided into 22 equal arcs, each arc being as much as the earth goes through in eight days. The points of division are marked with the letters *a, b, c, d, e, f,* &c. and show as many several stations from whence Mercury may be viewed from the earth. Suppose then the planet to be at 1 and the earth at *a*; draw a line from *a* to 1, and it shews Mercury's geocentric place at A. In eight days he will be got to 2, and the earth to *b*; draw a line from 2 to *b*, and it shows his geocentric place at B. In other eight days he will have proceeded to 3, and the earth to *c*; a line drawn from 3 to *c* will show his geocentric place at C. In this manner, going through the figure, and drawing lines from the earth at *d, e, f, g,* &c. through 4, 5, 6, 7, &c. we shall find his geocentric places successively at the points D, E, F, G, &c. where we may observe, that from A to B, and from B to C, the motion is direct; from C to D, and from D to E, retrograde. In this figure 22 stations are marked in the earth's orbit, from whence the planet may be viewed; corresponding to which there ought to be as many in the orbit of Mercury; and for this purpose the place of that planet is marked at the end of every eight days for two of his periodical revolutions; and to denote this, two numeral figures are placed at each division.

The geocentric motion of Venus may be explained in a similar manner; only as the motion of Venus is much slower than that of Mercury, his conjunctions, oppositions, elongations, and stations all return much more frequently than those of Venus.

To explain the stationary appearances of the planets, it must be remembered, that the diameter of the earth's orbit, and even that of Saturn, are but mere points in comparison of the distance of the fixed stars; and therefore, any two lines absolutely parallel, though drawn at the distance of the diameter of Saturn's orbit from each other; would, if continued to the fixed stars, appear to us to terminate in the same point. Let, then, the two circles fig. 143. represent the orbits of Venus and of the Earth; let the lines AE, BF, CG, DH, be parallel to SP, we may nevertheless affirm, that if continued to the distance of the fixed stars, they would all terminate in the same point with the line SP. Suppose then, Venus at E while the Earth is at A, the visual ray by which she is seen is the line AE. Suppose again, that while Venus goes from E to F, the Earth goes from A to B, the visual ray by which Venus is now seen is BF parallel to AE; and therefore Venus will be all that time stationary, appearing in that point of the heaven where SP extended would terminate: this station is at her changing from direct to retrograde. Again, suppose, when the Earth is at C, Venus is at G, and the visual line CG; if, while the Earth goes from C to D, Venus goes from G to H, so that she is seen in the line GH parallel to CG, she will be all that time stationary, appearing in the point where a line drawn from S through P would terminate. This station is at her changing from retrograde to direct; and both are in her inferior semicircle.

325 Perigee and apogee of the planets explained.

An inferior planet, when in conjunction with the sun in its inferior semicircle, is said to be in *perigee*, and in the other in *apogee*, on account of its different distances from the earth. Their real distances from the earth when in perigee are variable, partly owing to the eccentricities of their orbits, as well as that of the earth; and partly owing to the motions of the different bodies, by which it happens that they are in perigee in different parts of their orbits. The least possible distance is when the perigee happens when the earth is in its perihelion, and the planet in its aphelion.

326 Differences in the apparent diameters of the planets.

The difference of distance between the earth and inferior planets at different times, makes a considerable variation in their apparent diameters, which indeed is very observable in all the planets; and thus they sometimes look very considerably larger than at others. This difference in magnitude in Mercury is nearly as $5\frac{1}{4}$ to 1; and in Venus, no less than 32 to 1. A common spectator, unassisted by any instrument, may observe an inferior planet alternately approach nearer and nearer the sun, until at last it comes into conjunction with him, and then to recede farther and farther till it is at its greatest elongation, which will be first on one side and then on the other: but if we observe the apparent change of place of an inferior planet in the sphere of the heavens, its direct motions, stations, and retrogradations, measuring its diameter frequently with the micrometer,

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micrometer, we shall find by its decrease at some times and increase at others, that its distance from us is very considerably varied; so that, taking the whole of its course into consideration, it appears to move in a very complicated curve. See fig. 1. and C.

327 Appearances of the superior planets explained.

As the superior planets move in a larger orbit than the earth, they can only be in conjunction with the sun when they are on that side opposite to the earth; as, on the other hand, they are in opposition to him when the earth is between the sun and them. They are in quadrature with him when their geocentric places are 90° distant from that of the sun. In order to understand their apparent motions, we shall suppose them to stand still in some part of their orbit while the earth makes a complete revolution in hers; in which case, any superior planet would then have the following appearances: 1. While the earth is in her most distant semicircle, the motion of the planet will be direct. 2. While the earth is in her nearest semicircle, the planet will be retrograde. 3. While the earth is near those places of its orbit where a line drawn from the planet would be a tangent, it would appear to be stationary. Thus, in fig. 147. let *a b c d* represent the orbit of the Earth; S the Sun; EFG an arc of the orbit of Jupiter; ABC an arc of the ecliptic projected on the sphere of the fixed stars. Suppose Jupiter to continue at F, while the earth goes round in her orbit according to the order of the letters *a b c d*. While the earth is in the semicircle most distant from Jupiter going from *a* to *b* and from *b* to *c*, his motion in the heaven would appear direct, or from A to B and from B to C: but while the earth is in its nearest semicircle *c d e*, the motion of Jupiter would appear retrograde from C to B and from B to A; for *a*, *b*, *c*, *d*, may be considered as so many different stations from whence an inhabitant of the earth would view Jupiter at different seasons of the year, and a straight line drawn from each of these stations, through F the place of Jupiter, and continued to the ecliptic, would show his apparent place there to be successively at A, B, C, B, A. While the earth is near the points of contact *a* and *c*, Jupiter would appear stationary, because the visual ray drawn through both planets does not sensibly differ from the tangent F*a* or F*c*. When the earth is at *b*, a line drawn from *b* through S and F to the ecliptic, shows Jupiter to be in conjunction with the sun at B. When the earth is at *d*, a line drawn from *d* through S, continued to the ecliptic, would terminate in a point opposite to B; which shows Jupiter then to be in opposition to the sun: and thus it appears that his motion it direct in the conjunction, but retrograde when in opposition with the sun.

The direct motion of a superior planet is swifter the nearer it is to a conjunction, and slower as it approaches to a quadrature with the sun. Thus, in fig. 144. let ☉ be the sun; the little circle round it, the orbit of the earth, whereof *a b c d e f g* is the most distant semicircle: OPQ, an arc of the orbit of Jupiter; and ABCDEFG, an arc of the ecliptic in the sphere of the fixed stars. If we suppose Jupiter to stand still at P, by the earth's motion from *a* to *g*, he would appear to move direct from A to G, describing the unequal arcs AB, BC, CD, DE, EF, FG, in equal times. When the earth is at *d*, Jupiter is in conjunction with the sun at D, and there his direct motion is swiftest. When the earth is in that part of her orbit where a line drawn from Jupiter would touch it, as in the points *e* or *g*, Jupiter is nearly in quadrature with the sun; and the nearer the earth is to any of those points, the slower is the geocentric motion of Jupiter; for the arcs CD and DE are greater than BC or EF, and the arcs BC and EF are greater than AB or FG.

The retrograde motion of a superior planet is swifter the nearer it is to an opposition, and slower as it approaches to a quadrature with the sun. Thus, let ☉, fig. 145. be the sun; the little circle round it the orbit of the earth, whereof *g h i k l m n* is the nearest semicircle; OPQ, an arc of the orbit of Jupiter; NKG an arc of the ecliptic: If we suppose Jupiter to stand still at P, by the earth's motion from *g* to *n*, he would appear to move retrograde from G to N, describing the unequal arcs GH, HI, IK, KL, LM, MN, in equal times. When the earth is at *k*, Jupiter appears at K, in opposition to the sun, and there his retrograde motion is swiftest. When the earth is either at *g* or *n*, the points of contact of the tangents P*g* and P*n*, Jupiter is nearly in quadrature with the sun: and the nearer he is to either of these points, the slower is his retrogradation, for the arcs IK and KL are greater than HI or LM; and the arcs HI and LM are greater than GH or MN. Since the direct motion is swiftest when the earth is at *d*, and continues diminishing till it changes to retrogade, it must be insensible near the time of change: and, in like manner, the retrograde motion being swiftest when the earth is in *k*, and diminishing gradually till it changes to direct, must also at the time of that change be insensible; for any motion gradually decreasing till it changes into a contrary one gradually increasing, must at the time of the change be altogether insensible.

The same changes in the apparent motions of this planet will also take place if we suppose him to go on slowly in his orbit; only they will happen every year when the earth is in different parts of her orbit, and consequently different times of the year. Thus, (fig. 147.) let us suppose, that while the earth goes round her orbit Jupiter goes from F to G, the points of the earth's orbit from which Jupiter will now appear to be stationary will be *a* and *y*; and consequently his stations must be at a time of the year different from the former. Moreover, the conjunction of Jupiter with the sun will now be when the earth is at *f*, and his opposition when it is at *e*; for which reason these also will happen at times of the year different from those of the preceding opposition and conjunction. The motion of Saturn is so slow, that it makes but little alteration either in the times or places of his conjunction or opposition; and no doubt the same will take place in a more eminent degree in the Georgium Sidus; but the motion of Mars is so much swifter than even that of Jupiter, that both the times and places of his conjunctions and oppositions are thereby very much altered.

Fig. 148. exemplifies the geocentric motion of Jupiter in a very intelligible manner: where ☉ represents the sun; the circle 1, 2, 3 4, the orbit of the earth, divided into twelve equal arcs for the twelve months of the year; PQ an arc of the orbit of Jupiter, containing as much as he goes through in a year, and divided in in like manner into twelve equal parts each as much

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as he goes through in a month. Now, suppose the earth to be at 1 when Jupiter is at *a*, a line drawn through 1 and *a* shows Jupiter's place in the celestial ecliptic to be at A. In a month's time the earth will have moved from 1 to 2, Jupiter from *a* to *b*; and a line drawn from 2 to *b* will show his geocentric place to be in B. In another month, the earth will be in 3, and Jupiter at C, and consequently his geocentric place will be at C; and in like manner his place may be found for the other months at D, E, F, &c. It is likewise easy to observe, that his geocentric motion is direct in the arcs AB, BC, ED, DE; retrograde in EF, FG, GH, HI; and direct again in IK, KL, LM, MN. The inequality of his geocentric motion is likewise apparent from the figure.

A superior planet is in apogee when in conjunction with the sun, and in perigee when in opposition; and every one of the superior planets is at its least possible distance from the earth where it is in perigee and perihelion at the same time. Their apparent diameters are variable, according to their distances, like those of the inferior planets; and this, as might naturally be expected, is most remarkable in the planet Mars, who is nearest us. In his nearest approach, this planet is 25 times larger than when farthest off, Jupiter twice and a half, and Saturn once and a half.

328 Of the Georgium Sidus.

The honour of discovering the new attendant of the sun, called the *Georgium Sidus*, is undoubtedly due to Mr Herschel; though Mr Robison, professor of Natural Philosophy in Edinburgh, has given strong reasons for supposing that it had been marked by several astronomers as a fixed star. It was first observed by Mr Herschel on the 13th of March 1781, near the foot of Castor, and his attention was drawn by its steady light. On applying an higher magnifying power to his telescope, it appeared manifestly to increase in diameter; and two days after, he observed that its place was changed. From these circumstances he concluded, that it was a comet: and sent an account of it as such to the astronomer-royal, which very soon spread all over Europe. It was not long, however, before it was known, by the English astronomers especially, to be a planet.

329 How discovered to be a planet.

The circumstances which led to this discovery were, its vicinity to the ecliptic, the direction of its motion, and its being nearly stationary at the time, in such a manner as corresponds with the like appearances of the other planets. The French astronomers, however, still imagined it to be a comet, although it had not that faint train of light which usually accompanies these bodies, nor would its successive appearances correspond with such an hypothesis; so that they were at last obliged to own that it went round the sun in an orbit nearly circular.

330 Computation of its distance, &c.

Its motion was first computed on this principle by Mr Lexel professor of astronomy at St Petersburgh; who showed, that a circular orbit, whose radius is about 19 times the distance of the earth from the sun, would agree very well with all the observations which had been made during the year 1781. On the 1st of December that year it was in opposition with the sun; whence one of its stations was certainly determined. In the mean time, however, as astronomers were every where engaged in making observations on the same star, it occurred to some, that it might possibly have been observed before, though not known to be a planet. Mr Bade of Berlin, who had just published a work containing all the catalogues of zodiacal stars which had appeared, was induced, by the observations which had been already made on the new planet, to consult these catalogues, in order to discover whether any star, marked by one astronomer and omitted by another, might not be the new planet in question. In the course of this inquiry, he found, that the star, N° 964 of Mayer's catalogue, had been unobserved by others, and only once by Mr Mayer himself, so that no motion could have been perceived by him. On this Mr Bade immediately directed his telescope to that part of the heavens where he might expect to find the star marked in Mayer's catalogue, but without success. At the same time, by the calculations already made concerning the new planet, he discovered, that its apparent place in the year 1756 ought to have been that of Mayer's star, and this was one of the years in which he was busied in his observations; and on farther inquiry it was found, that the star 964 had been discovered by Mr Mayer on the 15th of September 1756: So that it is now generally believed, that the star N° 964 of Mayer's catalogue was the new planet of Herschel.

Before the end of the year 1782, it was found, that the angular motion of the planet was increasing; which showed, that it was not moving in a circle, but in an eccentric orbit, and was approaching towards the sun. Astronomers, therefore, began to investigate the inequality of this angular heliocentric motion, in order to discover the form and position of the ellipsis described. This was a very difficult task, as the small inequality of motion showed that the orbit was nearly circular, and the arch already described was no more than one-fiftieth part of the whole circumference. It was, however, by no means easy, from the variation of curvature discoverable in this small arch, to determine to what part of the circumference it belongs: though the Professor is of opinion, that the supposition of its being the star 964 of Mayer's catalogue renders the calculation easy. On this supposition, its motion has been calculated by several astronomers, as well as by Mr Robison himself. He observes, however, that if we do not admit the identity of these stars, near half a century must elapse before we can determine the elements of this planet's motion with a precision equal to that of the others.

Some astronomers are of opinion, that the new planet is the same with the star N° 34 Tauri of the Britannic catalogue. "In this case (says Mr Robison), the elements will agree very well with Flamstead's observation of that star on December 13th 1690, being only 40″, or perhaps only 12″, to the westward of it; but the latitude differs more than two minutes from Flamstead's latitude, which is properly deduced from the zenith distance. This is too great an error for him to commit in the observation; and we should therefore reject the supposition on this account alone: But there are stronger reasons for rejecting it, arising from the disagreement of those elements with the observations made on the stations of the planet in October 1781 and in March and October 1782, which give a very near approximation of its distance from the sun. When compared with observations of the planet near its stationary

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tionary points in the spring, they give the geocentric latitude considerably too great, while they give it too small for the similar observations in autumn."

331 To find the time when any planet will return into the same apparent situation.

As the times of conjunction, utmost elongation, direct or retrograde motions of the inferior planets, depend on the combinations of their motions in their orbits with the motion of the earth in its orbit; any of these appearances will be more frequent in Mercury than in Venus, because the former moves with a swifter motion in his orbit, and consequently must more frequently pass through those places where he is in conjunction, &c. The time in which any of the inferior planets will return into a given situation, may be known by the following examples. Let fig. 149. represent the orbits of Venus and the earth. Let the earth be at E, Venus at V, when she is in the inferior conjunction with the sun in ♈. From S, Venus and the earth would appear in conjunction in ♎: let Venus go round her orbit, and return to V; the earth taking longer time to go round than Venus, will, in the mean time, go from E, only through a part of her orbit, and Venus must overtake the earth before she can have another inferior conjunction; that is, she must, besides an entire revolution, which is equal to four right angles, go through as much more angular motion round the sun as the earth has done in the mean time, so as to be in a right line between the sun and the earth. Suppose this is to happen when the earth is got to F and Venus to T, the angular motions of the earth and Venus performed in the same times are reciprocally as their periodical times: and therefore as the periodical time of the earth is to the periodical time of Venus; so is the angular motion of Venus, which is equal to four right angles, added to the angular motion of the earth, in the time between two like conjunctions of Venus, to the angular motion of the earth in the same time: and therefore, by division of proportion, as the difference between the periodical times of Venus and the earth is to the periodical time of Venus; so are four right angles, or 360°, to a fourth quantity; namely, to the angular motion or number of degrees which the earth goes in her orbit from the time of one conjunction of Venus to the next conjunction of the same kind. Now the periodical time of the earth is 365 days 6 hours or 8766 hours; the period of Venus 224 days 16 hours or 5392 hours; the difference is 3374 hours. Say then, As 3374 is to 5392, so are four right angles, or 360 degrees, to a fourth number, which is 575°; which the earth goes through in a year and 218 days. Were Venus therefore this day in an inferior conjunction with the sun, it would be a year and 218 days before she come into another conjunction of the same kind; and this alteration in time occasions a proportionable change in place: so that if one conjunction be in ♈, the next similar conjunction will be in ♍. The time between any situation of Mercury, with regard to the sun and the earth, and another like situation, may be found by the same method. The periodical time of the earth is 8766 hours; the period of Mercury 87 days 23 hours or 2111 hours; the difference 6655 hours. Say then, As 6655 is to 2111, so are four right angles or 360° to 114°, through which the earth passes in 116 days. If therefore Mercury were to be this day in his inferior conjunction, it would be 116 days before he were in a similar situation.

Eucl. Elm. 5. prop 17.

This problem is commonly resolved in another manner. Astronomers compute the diurnal heliocentric motions of Venus and of the earth: the difference of these motions is the diurnal motion of Venus from the earth, or the quantity by which Venus would be seen to recede from the earth every day by a spectator placed in the sun: thus the mean motion of Venus is, every day about 59 minutes and 8 seconds; the difference is 37 minutes. Say, therefore, As 37 minutes is to 36°, or to 21,600 minutes, so is one day to the time wherein Venus, having left the earth, recedes from her 360 degrees; that is, to the time wherein she returns to the earth again, or the time between two conjunctions of the same kind.

332 To find the true times of the conjunctions, oppositions, &c of the planets.

The times are here computed according to the mean or equable motions of the planets; and this is therefore called a mean conjunction: but because Venus and the earth are really carried in elliptic orbits, in which their motions are sometimes swifter and sometimes slower, the true conjunctions may happen some days either sooner or later than what these rules will give. The time of the true conjunction is to be computed from that of the mean conjunction in the following manner. Find by astronomical tables the places of Venus and the earth in the ecliptic, from which we shall have the distance of the two as seen from the sun; compute also for the same time the triangular motions of these two planets for any given time, suppose six hours; the difference of these two motions will give the access of Venus to the earth, or her recess from it in six hours: then say, as this difference is to the arc between the places of Venus and the earth at the time of a mean conjunction, so is six hours to the time between the mean conjunction and the true. This time added to or subtracted from the time of the mean conjunction, according as Venus is in antecedence or consequence from the earth, shows the time of their true conjunction.

With regard to the conjunctions, oppositions, direct and retrograde motions, &c. of the superior planets, as they depend on the combinations of their motions with that of the earth, they will be more frequent in Saturn than in Jupiter, in Jupiter than in Mars, but most frequent of all in the Georgium Sidus; because the slower the motion of the planet is, the sooner the earth will overtake it, so as to have it again in any given situation. Thus, suppose Saturn to be in conjunction with the sun in ♈, if he were to stand still for one year, then he would again be in conjunction in ♈; but as he goes on slowly, according to the order of the signs, about 12° annually, the earth must go through almost 13° more than an entire revolution; so that there will be almost a year and 13 days between any conjunction between the Sun and Saturn and the conjunction immediately following. As Jupiter moves in his orbit with greater velocity than Saturn, the earth must have a proportionably larger space added to the year; and as Mars moves swifter still, the time betwixt any two of his conjunctions must be still longer.

The time when a superior planet will return into any given situation may be found by the methods already

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ready laid down for the inferior planets. Thus, the mean diurnal motion of the earth is about 59′ 8″; the mean motion of Saturn in a day is only two minutes; the difference 57′ 8″. Say therefore, As 57′ 8″ are to 360°, or 21,600 minutes, so is one day to the space of time wherein the earth having left Saturn recedes from him 360°; that is, to the time of her return to Saturn again, or the time between two conjunctions, oppositions, or other like aspects. This time will be found 378 days, or one year and 13 days. The mean motion of Jupiter in a day is 4′ 59″; the difference between this and the earth's diurnal motion is 54′ 59″. Say then, As 54′ 59″ are to 360° or 21,600′, so is one day to the space of time when the earth, having left Jupiter, will overtake him again; which will be found to be 398 days, or one year and 33 days. The mean motion of Mars is 31′ 27″; the difference between which and the earth's diurnal motion is 27′ 41″. Say then, As 27′ 41″ are to 360° or 21,600′, so is one day to the space of time wherein the earth, having left Mars, recedes from him 360°; which will be found two years and 50 days. The true conjunctions, &c. may be found in the superior planets as in the inferior.

333 Distance, &c. of the earth.

The earth is the next planet above Venus in the system. It is 95,173,000 miles from the sun; and goes round him in 365 days 5 hours 49 minutes, from any equinox or solstice to the same again; but from any fixed star to the same again, as seen from the sun, in 365 days 6 hours 9 minutes; the former being the length of the tropical year, and the latter the length of the sidereal. It travels at the rate of 68,000 miles every hour; which motion, though upwards of 140 times swifter than that of a cannon ball, is little more than half as swift as Mecury's motion in his orbit. The earth's diameter is 7970 miles; and by turning round its axis every 24 hours from west to east, it causes an apparent diurnal motion of all the heavenly bodies from east to west. By this rapid motion of the earth on its axis, the inhabitants about the equator are carried 1042 miles every hour, whilst those on the parallel of London are carried only about 580, besides the 68,000 miles by the annual motion abovementioned, which is common to all places whatever.

That the earth is of a globular figure may be proved from several different and evident circumstances. 1. When we are at sea on board a ship, we may be out of sight of land when the land is near enough to be visible if it were not hid from our eye by the convexity of the water. Thus, let ABCD (fig. 154.) represent a portion of the globe of our earth. Let M be the top of a mountain; this cannot be seen by a person on board the ship at B, because a line drawn from M to his eye at E is intercepted by the convexity of the water, but let the ship come to C, then the mountain will be visible, because a line may be drawn from M to his eye at E. 2. The higher the eye, the further will the view be extended. It is very common for sailors from the top of the mast of a ship to discover land or ships at a much greater distance than they can do when they stand upon deck. 3. When we stand on shore, the highest part of a ship is visible at the greatest distance. If a ship is going from us out to sea, we shall continue to see the mast after the hull or body of the ship disappears, and the top of the mast will continue to be seen the longest. If a ship is coming towards us, the top of the mast comes first in view, and we see more and more till at last the hull appears. If the surface of the sea were a flat plain (fig. 155.), a line might be drawn from any object situated upon it, as the ship D, to the eye, whether placed high or low, at A or B. In this case, any object upon the earth or sea, would be visible at any distance which was not so great as to make the appearance of it too faint, or the angle under which it appears too small, to be seen by us. An object would be visible at the same distance, whether the eye were high or low. Not the highest, but the largest, objects would be visible to the greatest distance, so that we should be able to see the hulk of a ship further off than the mast: All which is contrary to experience. 4. Several navigators, such as Ferdinand Magellan, Sir Francis Drake, Captain Cook, have sailed round the globe; not in an exact circle, the land preventing them, but by going in and out as the shores happened to lie. 5. All the appearances in the heavens are the same, whether at land or sea. 6. Eclipses of the moon arise from the shadow of the earth, and this shadow is always circular. Although the earth presents, during several hours, different portions of its surface to the moon, yet still the shadow is round. The small inequalities upon the surface of the earth bear no kind of proportion to its magnitude sufficient to alter the appearance of its shadow.

The earth's axis makes an angle of 23½ degrees with the axis of its orbit, and keeps always the same oblique direction, inclining nearly to the same fixed stars (A) throughout its annual course, which causes the returns of spring, summer, autumn, and winter.

334 Demonstration of the earth's motion.

That the sun, and not the earth, is the centre of our solar system, may be demonstrated beyond a possibility of doubt, from considering the forces of gravitation and projection, by which all the celestial bodies are retained in their orbits. For, if the sun moves about the earth, the earth's attractive power must draw the sun towards it from the line of projection so as to bend its motion into a curve: But the sun being at least 227,000 times as heavy as the earth, by being so much weightier as its quantity of matter is greater, it must move 227,000 times as slowly towards the earth as the earth does towards the sun; and consequently the earth would fall to the sun in a short time, if it had not a very strong projectile motion to carry it off. The earth, therefore, as well as every other planet in the system, must have a rectilineal impulse, to prevent its falling into the sun. To say, that gravitation retains

(A) This is not strictly true, as will appear when we come to treat of the recession of the equinoctial points in the heavens, which recession is equal to the deviation of the earth's axis from its parallelism: but this is rather too small to be sensible in an age, except to those who make very nice observations.

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tains all the other planets in their orbits without affecting the earth, which is placed between the orbits of Mars and Venus, is as abſurd as to ſuppoſe that ſix cannon-bullets might be projected upwards to different heights in the air, and that five of them ſhould fall down to the ground; but the ſixth, which is neither the higheſt nor the loweſt, ſhould remain ſuſpended in the air without falling, and the earth move round about it.

There is no ſuch thing in nature as a heavy body moving round a light one as its center of motion. A pebble faſtened to a mill-ſtone by a ſtring, may by an eaſy impulſe be made to circulate round the mill-ſtone: but no impulſe can make a mill-ſtone circulate round a looſe pebble; for the mill-ſtone would go off, and carry the pebble along with it.

The ſun is ſo immenſely bigger and heavier than the earth, that, if he was moved out of his place, not only the earth, but all the other planets, if they were united into one maſs, would be carried along with the ſun as the pebble would be with the mill-ſtone.

335
From the proportional decreaſe of gravity, &c.

By conſidering the law of gravitation, which takes place throughout the ſolar ſyſtem, in another light, it will be evident that the earth moves round the ſun in a year, and not the ſun round the earth. It has been obſerved, that the power of gravity decreaſes as the ſquare of the diſtance increaſes; and from this it follows with mathematical certainty, that when two or more bodies move round another as their centre of motion, the ſquares of their periodic times would be to one another in the ſame proportion as the cubes of their diſtances from the central body. This holds preciſely with regard to the planets round the ſun, and the ſatellites round the planets; the relative diſtances of all which are well known. But, if we ſuppoſe the ſun to move round the earth, and compare its period with the moon's by the above rule, it will be found that the ſun would take no leſs than 173,510 days to move round the earth; in which caſe our year would be 475 times as long as it now is. To this we may add, that the aſpects of increaſe and decreaſe of the planets, the times of their ſeeming to ſtand ſtill, and to move direct and retrograde, anſwer preciſely to the earth's motion, but not at all to the ſun's, without introducing the moſt abſurd and monſtrous ſuppoſitions, which would deſtroy all harmony, order, and ſimplicity, in the ſyſtem. Moreover, if the earth be ſuppoſed to ſtand ſtill, and the ſtars to revolve in free ſpaces about the earth in 24 hours, it is certain that the forces by which the ſtars revolve in their orbits are not directed to the earth, but to the centres of the ſeveral orbits, that is, of the ſeveral parallel circles which the ſtars on different ſides of the equator deſcribe every day: and the like inferences may be drawn from the ſuppoſed diurnal motion of the planets, ſince they are never in the equinoctial but twice, in their courſes with regard to the ſtarry heavens. But, that forces ſhould be directed to no central body, on which they phyſically depend, but to innumerable imaginary points in the axis of the earth produced to the poles of the heavens, is an hypotheſis too abſurd to be allowed of by any rational creature. And it is ſtill more abſurd to imagine, that theſe forces ſhould increaſe exactly in proportion to the diſtances from this axis; for this is an indication of an increaſe to infinity; whereas the force of attraction is found to decreaſe in receding from the fountain from whence it flows. But the farther any ſtar is from the quieſcent pole, the greater muſt be the orbit which it deſcribes; and yet it appears to go round in the ſame time as the neareſt ſtar to the pole does. And if we take into conſideration the twofold motion obſerved in the ſtars, one diurnal round the axis of the earth in 24 hours, and the other round the axis of the ecliptic in 25,920 years, it would require an explication of ſuch a perplexed compoſition of forces, as could by no means be reconciled with any phyſical theory.

336
Objection againſt the earth's motion anſwered.

The ſtrongeſt objection that can be made againſt the earth's motion round the ſun is, that in oppoſite points of the earth's orbit, its axis, which always keeps a parallel direction, would point to different fixed ſtars; which is not found to be fact. But this objection is eaſily removed, by conſidering the immenſe diſtance of the ſtars in reſpect of the diameter of the earth's orbit; the latter being no more than a point when compared to the former. If we lay a ruler on the ſide of a table, and along the edge of the ruler view the top of a ſpire at ten miles diſtance; then lay the ruler on the oppoſite ſide of the table, in a parallel ſituation to what it had before, and the ſpire will ſtill appear along the edge of the rule; becauſe our eyes, even when aſſiſted by the beſt inſtruments, are incapable of diſtinguiſhing ſo ſmall a change at ſo great a diſtance.

337
Earth's motion demonſtrated from the aberration of light.

Dr Bradley, our late aſtronomer-royal, found by a long ſeries of the moſt accurate obſervations, that there is a ſmall apparent motion of the fixed ſtars, occaſioned by the aberration of their light; and ſo exactly anſwering to an annual motion of the earth, as evinces the ſame, even to a mathematical demonſtration. He conſidered this matter in the following manner: he imagined CA, fig. 33. to be a ray of light falling perpendicularly upon the line BD; that if the eye is at reſt at A, the object muſt appear in the direction AC, whether light be propagated in time or in an inſtant. But if the eye is moving from B towards A, and light is propagated in time, with a velocity that is to the velocity of the eye, as CA to BA; then light moving from C to A, whilſt the eye moves from B to A, that particle of it by which the object will be diſcerned when the eye comes to A, is at C when the eye is at B. Joining the points BC, he ſuppoſed the line CB to be a tube, inclined to the line BD in the angle DBC, of ſuch diameter as to admit but one particle of light. Then it was eaſy to conceive, that the particle of light at C, by which the object muſt be ſeen, when the eye, as it moves along, arrives at A, would paſs through the tube BC, if it is inclined to BD in the the angle BDC, and accompanies the eye in its motion from B to A; and that it could not come to the eye placed behind ſuch a tube, if it had any other inclination to the line BD. If, inſtead of ſuppoſing CB ſo ſmall a tube, we imagine it to be the axis of a larger; then, for the ſame reaſon, the particle of light at C would not paſs through the axis, unleſs it is inclined to BD in the angle CBD. In like manner, if the eye moved the contrary way, from D towards A, with the ſame velocity, then the tube muſt be inclined in the angle BCD. Although, therefore, the true or real place of an object is perpendicular to the line in which the eye is moving, yet the viſible place will not be ſo; ſince that, no doubt, muſt be in the direction of the tube;

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tube; but the difference between the true and apparent place will be *cæteris paribus*, greater or less, according to the different proportion between the velocity of light and that of the eye. So that, if we could suppose that light was propagated in an instant, then there would be no difference between the real and visible place of an object, although the eye was in motion: for in that case, AC being infinite with respect to AB, the angle ACB, the difference between the true and visible place, vanishes. But if light be propagated in time, it is evident, from the foregoing considerations, that there will be always a difference between the real and visible place of an object, unless the eye is moving either directly towards or from the object. And in all cases the sine of the difference between the real and visible place of the object will be to the sine of the visible inclination of the object to the line in which the eye is moving, as the velocity of eye is to the velocity of light.

He then shows, that if the earth revolve round the sun annually, and the velocity of light be to the velocity of the earth's motion in its orbit, as 1000 to 1, that a star really placed in the very pole of the ecliptic would, to an eye carried along with the earth, seem to change its place continually; and, neglecting the small difference on the account of the earth's diurnal revolution on its axis, would seem to describe a circle round that pole every way distant from it $3\frac{1}{2}$; so that its longitude would be varied through all the points of the ecliptic every year, but its latitude would always remain the same. Its right ascension would also change, and its declination, according to the different situation of the sun with respect to the equinoctial points, and its apparent distance from the north pole of the equator, would be 7′ less at the autumnal than at the vernal equinox.

338
Velocity of light.

By calculating exactly the quantity of abberration of the fixed stars from their place, he found that light came from the sun to us in 8′ 13″; so that its velocity is to the velocity of the earth in its orbit as 10,201 to 1.

339
Errors in the observation of small angles.

It must here be taken notice of, however, that Mr Nevil Maskelyne, in attempting to find the parallax of Sirius, with a ten-feet sector, observed that by the friction of the plummet line on the pin which suspended it, and error of 10″, 20″, and sometimes 30″, was committed. The pin was $\frac{1}{20}$ of an inch diameter; and though he reduced it to $\frac{1}{70}$ of an inch, the error still amounted to 3″. All observations, therefore, that have hitherto been made in order to discover the parallax of the fixed stars, are to be disregarded.

340
Another objection against the earth's motion answered.

It is also objected, that the sun seems to change his place daily, so as to make a tour round the stary heavens in a year. But whether the sun or earth moves, this appearance will be the same, for when the earth is in any part of the heavens, the sun will appear in the opposite. And therefore, this appearance can be no objection against the motion of the earth.

It is well known to every person who has sailed on smooth water, or been carried by a stream in a calm, that, however fast the vessel goes, he does not feel its progressive motion. The motion of the earth is incomparably more smooth and uniform than that of a ship, or any machine made and moved by human art; and therefore it is not to be imagined that we can feel its motion.

We find that the sun, and those planets on which there are visible spots, turn round their axis: for the spots move regularly over their disks (B.) From hence we may reasonably conclude, that the other planets on which we see no spots, and the earth, which is likewise a planet, have such rotations. But being incapable of leaving the earth, and viewing it at a distance, and its rotation being smooth and uniform, we can neither see it move on its axis as we do the planets, nor feel ourselves affected by its motion. Yet there is one effect of such a motion, which will enable us to judge with certainty whether the earth revolves on its axis or not. All globes which do not turn round their axis will be perfect spheres, on account of the equality of the weight of bodies on their surfaces; especially of the fluid parts. But all globes which turn on their axes will be oblate spheroids; that is, their surfaces will be higher or farther from the centre in the equatorial than in the polar regions: for as the equatorial parts move quickest, they will recede farthest from the axis of motion, and enlarge the equatorial diameter. That our earth is really of this figure, is demonstrable from the unequal vibrations of a pendulum, and the unequal lengths of degrees in different latitudes. Since then the earth is higher at the equator than at the poles, the sea, which naturally runs downward, or toward the places which are nearest the centre, would run towards the polar regions, and leave the equatorial parts dry, if the centrifugal force of these parts, by which the waters were carried thither, did not keep them from returning. The earth's equatorial diameter is 36 miles longer than its axis.

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Argument for the earth's motion from its spheroidal figure.

342
Weight of bodies increases towards the poles.

Bodies near the poles are heavier than those towards the equator, because they are nearer the earth's centre, where the whole force of the earth's attraction is accumulated. They are also heavier, because their centrifugal force is less, on account of their diurnal motion being slower. For both these reasons, bodies carried from the poles toward the equator gradually lose their weight. Experiments prove, that a pendulum which vibrates seconds near the poles vibrates slower near the equator, which shows that it is lighter or less attracted there. To make it oscillate in the same time, it is found necessary to diminish its length. By comparing the different lengths of pendulums swinging seconds at the equator and at London, it is found that a pendulum must be $2\frac{169}{1000}$ lines shorter at the equator than at the poles. A line is a twelfth part of an inch.

If the earth turned round its axis in 84 minutes 43 seconds, the centrifugal force would be equal to the power of gravity at the equator: and all bodies there would entirely lose their weight. If the earth revolved quicker, they would all fly off and leave it,

A person on the earth can no more be sensible of its undisturbed motion on its axis, than one in the cabbin of

(B.) This, however, must be understood with some degree of limitation, as will evidently appear from what has been already said concerning the variable motion both of the spots of the sun and planets.

Fig 162

Irregularities of the Moons Motion

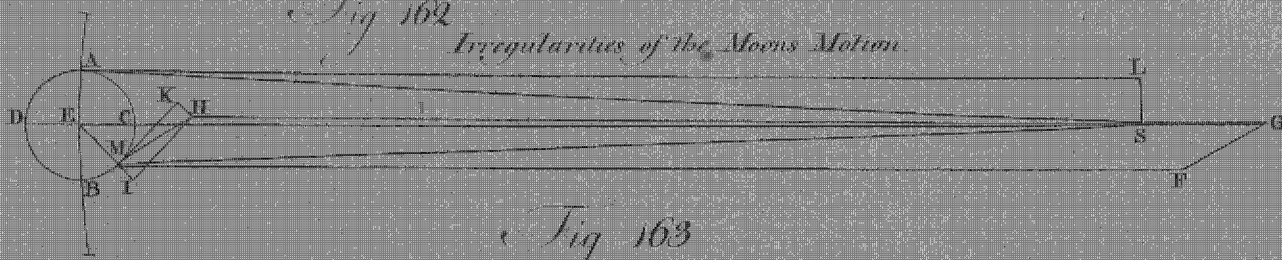


Fig 163

Irregularities of the Moons Motion

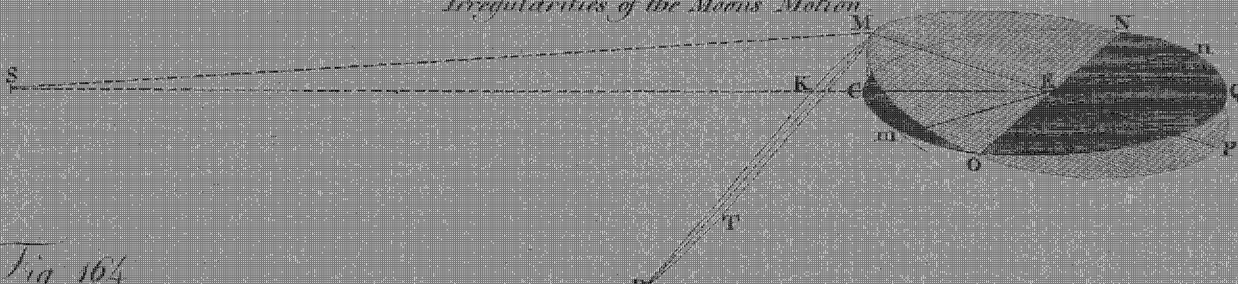
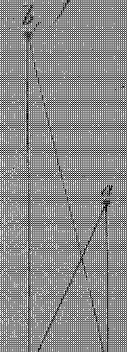


Fig 164



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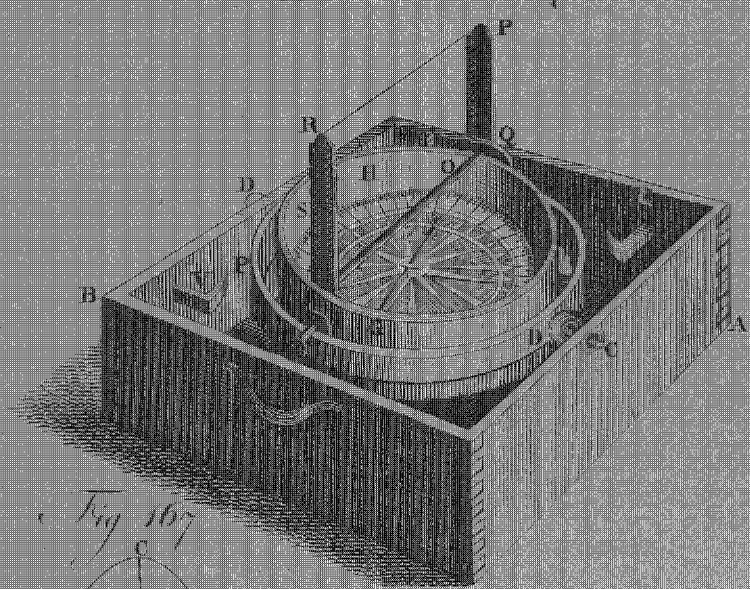


Fig 165

Fig 166

Fig 167

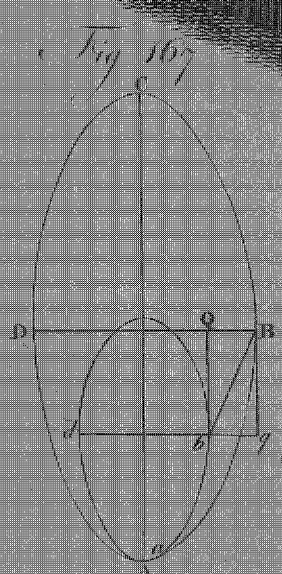


Fig 168

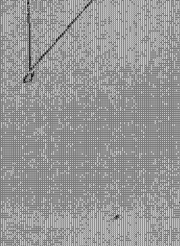
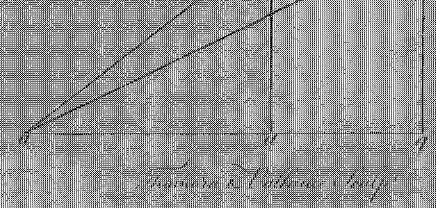


Fig 169



Thomson & Vallance Sculp.

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of a ſhip on ſmooth water can be ſenſible of the ſhip's motion when it turns gently and uniformly round. It is therefore no argument againſt the earth's diurnal motion, that we do not feel it: nor is the apparent revolutions of the celeſtial bodies every day a proof of the reality of theſe motions; for whether we or they revolve, the appearance is the very ſame. A perſon looking through the cabin-windows of a ſhip, as ſtrongly fancies the objects on land to go round when the ſhip turns as if they were actually in motion.

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Earth's motion proved from the celeſtial appearances from different planets.

If we could tranſlate ourſelves from planet to planet, we ſhould ſtill find that the ſtars would appear of the ſame magnitudes, and at the ſame diſtances from each other, as they do to us here; becauſe the width of the remoteſt planet's orbit bears no ſenſible proportion to the diſtance of the ſtars. But then the heavens would ſeem to revolve about very different axes; and conſequently, thoſe quieſcent points, which are our poles in the heavens, would ſeem to revolve about other points, which, though apparently in motion as ſeen from the earth, would be at reſt as ſeen from any other planet. Thus the axis of Venus, which lies at right angles to the axis of the earth, would have its motionleſs poles in two oppoſite points of the heavens lying almoſt in our equinoctial, where the motion appears quickeſt, becauſe it is ſeemingly performed in the greateſt circle: and the very poles, which are at reſt to us, have the quickeſt motion of all as ſeen from Venus. To Mars and Jupiter the heavens appear to turn round with very different velocities on the ſame axis, whoſe poles are about 23½ degrees from ours. Were we on Jupiter, we ſhould be at firſt amazed at the rapid motion of the heavens; the ſun and ſtars going round in 9 hours 56 minutes. Could we go from thence to Venus, we ſhould be as much ſurpriſed at the ſlowneſs of the heavenly motions; the ſun going but once round in 584 hours, and the ſtars in 540. And could we go from Venus to the moon, we ſhould ſee the heavens turn round with a yet ſlower motion; the ſun in 708 hours, the ſtars in 655. As it is impoſſible theſe various circumvolutions in ſuch different times, and on ſuch different axes, can be real, ſo it is unreaſonable to ſuppoſe the heavens to revolve about our earth more than it does about any other planet. When we reflect on the vaſt diſtance of the fixed ſtars, to which 190,000,000 of miles, the diameter of the earth's orbit, is but a point, we are filled with amazement at the immenſity of their diſtance. But if we try to frame an idea of the extreme rapidity with which the ſtars muſt move, if they move round the earth in 24 hours, the thought becomes ſo much too big for our imagination, that we can no more conceive it than we do infinity or eternity. If the ſun was to go round the earth in 24 hours, he muſt travel upwards of 300,000 miles in a minute: but the ſtars being at leaſt 400,000 times as far from the ſun as the ſun is from us, thoſe about the equator muſt move 400,000 times as quick. And all this to ſerve no other purpoſe than what can be as fully and much more ſimply obtained by the earth's turning round eaſtward, as on an axis, every 24 hours, cauſing thereby an apparent diurnal motion of the ſun weſtward, and bringing about the alternate returns of day and night.

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Another objection anſwered.

As to the common objections againſt the earth's motion on its axis, they are all eaſily anſwered and ſet aſide. That it may turn without being ſeen or felt by us to do ſo, has been already ſhown. But ſome are apt to imagine, that if the earth turns eaſtward (as it certainly does if it turns at all), a ball fired perpendicularly upward in the air muſt fall conſiderably weſtward of the place it was projected from. The objection, which at firſt ſeems to have ſome weight, will be found to have none at all, when we conſider that the gun and ball partake of the earth's motion; and therefore the ball being carried forward with the air as quick as the earth and air turn, muſt fall down on the ſame place. A ſtone let fall from the top of a mainmaſt, if it meets with no obſtacle, falls on the deck as near the foot of the maſt when the ſhip ſails as when it does not. If an inverted bottle full of liquor be hung up to the ceiling of the cabin, and a ſmall hole be made in the cork to let the liquor drop through on the floor, the drops will fall juſt as far forward on the floor when the ſhip ſails as when it is at reſt. And gnats or flies can as eaſily dance among one another in a moving cabin as in a fixed chamber. As for thoſe ſcripture expreſſions which ſeem to contradict the earth's motion, this general anſwer may be made to them all, viz. It is plain from many inſtances, that the ſcriptures were never intended to inſtruct us in philoſophy or aſtronomy; and therefore on thoſe ſubjects expreſſions are not always to be be taken in the literal ſenſe, but for the moſt part as accommodated to the common apprehenſions of mankind. Men of ſenſe in all ages, when not treating of the ſciences purpoſely, have followed this method: and it would be in vain to follow any other in addreſſing ourſelves to the vulgar, or bulk of any community.

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Diurnal motion of the earth, and different changes of the ſeaſons, illuſtrated by experiment Fig. 172.

The following experiment will give a plain idea of the diurnal or annual motions of the earth, together with the different lengths of days and nights, and all the beautiful variety of ſeaſons, depending on thoſe motions.

Take about ſeven feet of ſtrong wire, and bend it into a circular form, as a b c d, which being viewed obliquely, appears elliptical, as in the figure. Place a lighted candle on a table; and having fixed one end of a ſilk thread K to the north pole of a ſmall terreſtrial globe H, about three inches diameter, cauſe another perſon to hold the wire circle, ſo that it may be parallel to the table, and as high as the flame of the candle I, which ſhould be in or near the centre. Then having twiſted the thread as towards the left hand, that by untwiſting it may turn the globe round eaſtward, or contrary to the way that the hands of a watch move, hang the globe by the thread within this circle, almoſt contiguous to it; and as the thread untwiſts, the globe (which is enlightened half round by the candle as the earth is by the ſun) will turn round its axis, and the different places upon it will be carried through the light and dark hemiſpheres, and have the appearance of a regular ſucceſſion of days and nights, as our earth has in reality by ſuch a motion. As the globe turns, move your hand ſlowly, ſo as to carry the globe round the candle according to the order of the letters a b c d, keeping its centre even with the wire circle; and you will perceive, that the candle, being ſtill perpendicular to the equator, will enlighten the globe from pole to pole in its whole motion round the circle; and that every place on the globe goes equally through the light and the dark, as it turns round by the untwiſting

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ing of the thread, and therefore has a perpetual equinox. The globe thus turning round represents the earth turning round its axis; and the motion of the globe round the candle represents the earth's annual motion round the sun; and shows, that if the earth's orbit had no inclination to its axis, all the days and nights of the year would be equally long, and there would be no different seasons. Hence also it appears why the planets Mars and Jupiter have a perpetual equinox, namely, because their axes are perpendicular to the planes of their orbits, as the thread round which the globe turns in this experiment is perpendicular to the plane of the area inclosed by the wire.—But now desire the person who holds the wire to hold it obliquely in the position ABCD, raising the side ♋ just as much as he depresses the side ♑, that the flame may be still in the plane of the circle; and twisting the thread as before, that the globe may turn round its axis the same way as you carry it round the candle; that is, from west to east; let the globe down into the lowermost part of the wire circle at ♑: and if the circle be properly inclined, the candle will shine perpendicularly on the tropic of Cancer; and the frigid zone, lying within the arctic or north polar circle, will be all in the light, as in the figure: and will keep in the light let the globe turn round its axis ever so often. From the equator to the north polar circle, all the places have longer days and shorter nights; but from the equator to the south polar circle, just the reverse. The sun does not set to any part of the north frigid zone, as shown by the candle's shining on it, so that the motion of the globe can carry no place of that zone into the dark; and at the same time the south frigid zone is involved in darkness, and the turning of the globe brings none of its places into the light. If the earth were to continue in the like part of its orbit, the sun would never set to the inhabitants of the north frigid zone, nor rise to those of the south. At the equator, it would be always equal day and night; and as places are gradually more and more distant from the equator towards the arctic circle, they would have longer days and shorter nights; whilst those on the south side of the equator would have their nights longer than their days. In this case, there would be continual summer on the north side of the equator, and continual winter on the south side of it.

But as the globe turns round its axis, move your hand slowly forward, so as to carry the globe from H towards E, and the boundary of light and darkness will approach towards the north pole, and recede towards the south pole; the northern places will go through less and less of the light, and the southern places through more and more of it; showing how the northern days decrease in length and the southern days increase, whilst the globe proceeds from H to E. When the globe is at E, it is at a mean state between the lowest and highest parts of its orbit; the candle is directly over the equator, the boundary of light and darkness just reaches to both the poles, and all places on the globe go equally through the light and dark hemispheres, showing that the days and nights are then equal to all places of the earth, the poles only excepted; for the sun is then setting to the north pole and rising to the south pole.

Continue moving the globe forward, and as it goes through the quarter A, the north pole recedes still farther into the dark hemisphere, and the south pole advances more into the light, as the globe comes nearer to ♋: and when it comes there at F, the candle is directly over the tropic of Capricorn; the days are at the shortest and nights at the longest, in the northern hemisphere, all the way from the equator to the arctic circle; and the reverse in the southern hemisphere from the equator to the antarctic circle; within which circles it is dark to the north frigid zone and light to the south.

Continue both motions; and as the globe moves through the quarter B, the north pole advances towards the light, and the south pole recedes towards the dark; the days lengthen in the northern hemisphere and shorten in the southern; and when the globe comes to G, the candle will be again over the equator (as when the globe was at E), and the days and nights will again be equal as formerly; and the north pole will be just coming into the light, the south pole going out of it.

Thus we see the reason why the days lengthen and shorten from the equator to the polar circles every year; why there is sometimes no day or night for many turnings of the earth, within the polar circles; why there is but one day and one night in the whole year at the poles; and why the days and nights are equally long all the year round at the equator, which is always equally cut by the circle bounding light and darkness.

The inclination of an axis or orbit is merely relative, because we compare it with some other axis or orbit which we consider as not inclined at all. Thus, our horizon being level to us, whatever place of the earth we are upon, we consider it as having no inclination; and yet, if we travel 90 degrees from that place, we shall then have an horizon perpendicular to the former; but it will still be level to us.

346 Different seasons particularly explained.

Let us now take a view of the earth in its annual course round the sun, considering its orbit as having no inclination; and its axis as inclining $23\frac{1}{2}$ degrees from a line perpendicular to the plane of its orbit, and keeping the same oblique direction in all parts of its annual course; or, as commonly termed, keeping always parallel to itself.

Let *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, be the earth in eight different parts of its orbit, equidistant from one another; N*s* its axis, N its north pole, *s* its south pole, and S the sun nearly in the centre of the earth's orbit. As the earth goes round the sun according to the order of the letters *abcd*, &c. its axis N*s* keeps the same obliquity, and is still parallel to the line MN*s*. When the earth is at *a*, its north pole inclines towards the sun S, and brings all the northern places more into the light than at any other time of the year. But when the earth is at *e* in the opposite time of the year, the north pole declines from the sun, which occasions the northern places to be more in the dark than in the light, and the reverse at the southern places; as is evident by the figure which is taken from Dr Long's astronomy. When the earth is either at *c* or *g*, its axis inclines not either to or from the sun, but lies sidewise to him, and then the poles are in the boundary of light and darkness; and the sun, being directly over the equator, makes equal day and night at all places. Fig. 174.

When

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When the earth is at *b*, it is half-way between the ſummer ſolſtice and harveſt equinox; when it is at *d*, it is half-way from the harveſt equinox to the winter ſolſtice; at *f*, half-way from the winter ſolſtice to the ſpring equinox; and at *h*, half-way from the ſpring equinox to the ſummer ſolſtice.

From this oblique view of the earth's orbit, let us ſuppoſe ourſelves to be raiſed far above it, and placed juſt over its centre S, looking down upon it from its north pole; and as the earth's orbit differs but very little from a circle, we ſhall have its figure in ſuch a view repreſented by the circle ABCDEFG. Let us ſuppoſe this circle to be divided into 12 equal parts, called *ſigns*, having their names affixed to them; and each ſign into 30 equal parts, called *degrees*, numbered 10, 20, 30, as in the outermoſt circle of the figure, which repreſents the great ecliptic in the heavens. The earth is ſhown in eight different poſitions in this circle; and in each poſition Æ is the equator, T the tropic of Cancer, the dotted circle the parallel of London, U the arctic or north polar circle, and P the north pole, where all the meridians or hour-circles meet. As the earth goes round the ſun, the north pole keeps conſtantly towards one part of the heavens, as it keeps in the figure towards the right-hand ſide of the plate.

Fig. 177.

When the earth is at the beginning of Libra, namely on the 20th of March, in this figure the ſun S as ſeen from the earth, appears at the beginning of Aries in the oppoſite part of the heavens, the north pole is juſt coming into the light, and the ſun is vertical to the equator; which, together with the tropic of Cancer, parallel of London, and arctic circle, are all equally cut by the circle bounding light and darkneſs, coinciding with the ſix-o'clock hour-circle, and therefore the days and nights are equally long at all places: for every part of the meridian ÆTL*a* comes into the light at ſix in the morning, and, revolving with the earth according to the order of the hour-letters, goes into the dark at ſix in the evening. There are 24 meridians or hour-circles drawn on the earth in this figure, to ſhow the time of ſun-riſing and ſetting at different ſeaſons of the year.

As the earth moves in the ecliptic according to the order of the letters ABCD, &c. through the ſigns Libra, Scorpio, and Sagittarius, the north pole P comes more and more into the light; the days increaſe as the nights decreaſe in length, at all places north of the equator Æ; which is plain by viewing the earth at *b* on the 5th of May, when it is in the 15th degree of Scorpio, and the ſun as ſeen from the earth appears in the 15th degree of Taurus. For then the tropic of Cancer T is in the light from a little after five in the morning till almoſt ſeven in the evening; the parallel of London, from half an hour paſt four till half an hour paſt ſeven; the polar circle U, from three till nine; and a large track round the north pole P has day all the 24 hours, for many rotations of the earth on its axis.

When the earth comes to *c* (fig. 174.) at the beginning of Capricorn, and the ſun as ſeen from the earth appears at the beginning of Cancer, on the 21ſt of June, as in this figure, it is in the poſition C in fig. 177; and its north pole inclines towards the ſun, ſo as to bring all the north frigid zone into the light, and the northern parallels of latitude more into the light than the dark from the equator to the polar circle; and the more ſo as they are farther from the equator. The tropic of Cancer is in the light from five in the morning till ſeven at night, the parallel of London from a quarter before four till a quarter after eight; and the polar circle juſt touches the dark, ſo that the ſun has only the lower half of his diſk hid from the inhabitants on that circle for a few minutes about midnight, ſuppoſing no inequalities in the horizon, and no refractions.

A bare view of the figure is enough to ſhow, that as the earth advances from Capricorn towards Aries, and the ſun appears to move from Cancer towards Libra, the north pole recedes from the light, which cauſes the days to decreaſe and the nights to increaſe in length, till the earth comes to the beginning of Aries, and then they are equal as before; for the boundary of light and darkneſs cuts the equator and all its parallels equally, or in halves. The north pole then goes into the dark, and continues therein until the earth goes halfway round its orbit; or, from the 23d of September till the 20th of March. In the middle between theſe times, viz. on the 22d of December, the north pole is as far as it can be in the dark, which is 23½ degrees, equal to the inclination of the earth's axis from a perpendicular to its orbit: and then the northern parallels are as much in the dark as they were in the light on the 21ſt of June; the winter nights being as long as the ſummer days, and the winter days as ſhort as the ſummer nights. Here it muſt be noted, that of all that has been ſaid of the northern hemiſphere, the contrary muſt be underſtood of the ſouthern; for on different ſides of the equator the ſeaſons are contrary, becauſe, when the northern hemiſphere inclines towards the ſun, the ſouthern declines from him.

347 Why the ſun appears bigger in winter than in ſummer.

The earth's orbit being elliptical, and the ſun conſtantly keeping in its lower focus, which is 1,617,941 miles from the middle point of the longer axis, the earth comes twice ſo much, or 3,235,882 miles nearer the ſun at one time of the year than at another; for the ſun appearing under a larger angle in our winter than ſummer, proves that the earth is nearer the ſun in winter. But here this natural queſtion will ariſe, Why have we not the hotteſt weather when the earth is neareſt the ſun? In anſwer it muſt be obſerved, that the eccentricity of the earth's orbit, or 1,617,941 miles, bears no greater proportion to the earth's mean diſtance from the ſun than 17 does to 1000; and therefore this ſmall difference of diſtance cannot occaſion any great difference of heat or cold. But the principal cauſe of this difference is, that in winter the ſun's rays fall ſo obliquely upon us, that any given number of them is ſpread over a much greater portion of the earth's ſurface where we live; and therefore each point muſt then have fewer rays than in ſummer. Moreover, there comes a greater degree of cold in the long winter-nights than there can return of heat in ſo ſhort days; and on both theſe accounts the the cold muſt increaſe. But in ſummer the ſun's rays fall more perpendicularly upon us; and therefore come with greater force, and in greater numbers, on the ſame place; and by their long continuance, a much greater degree of heat it imparted by day than can fly off by night. Beſides, thoſe parts which are once heated, retain the heat for ſome time; which, with the additional heat daily imparted, makes

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makes it continue to increase, though the sun declines towards the south: and this is the reason why July is hotter than June, although the sun has withdrawn from the summer tropic; as we find it is generally hotter at three in the afternoon, when the sun has gone towards the west, than at noon when he is on the meridian. Likewise those places which are well cooled require time to be heated again; for the sun's rays do not heat even the surface of any body till they have been some time upon it. And therefore we find January for the most part colder than December, although the sun has withdrawn from the winter tropic, and begins to dart his beams more perpendicularly upon us. An iron bar is not heated immediately upon being in the fire, nor grows cold till some time after it has been taken out.

It has been already observed, that by the earth's motion on its axis, there is more matter accumulated all around the equatorial parts than any where else on the earth.

The sun and moon, by attracting this redundancy of matter bring the equator sooner under them in every return towards it, than if there was no such accumulation. Therefore, if the sun sets out, as from any star or other fixed point in the heavens, the moment when he is departing from the equinoctial or from either tropic, he will come to the same equinox or tropic again 20 min. 17$\frac{1}{7}$ sec. of time, or 50 seconds of a degree, before he completes his course, so as to arrive at the same fixed star or point from whence he set out. For the equinoctial points recede 50 seconds of a degree westward every year, contrary to the sun's annual progressive motion.

When the sun arrives at the same equinoctial or solstitial point, he finishes what we call the *Tropical Year;* which, by observation, is found to contain 365 days 5 hours 48 minutes 57 seconds: and when he arrives at the same fixed star again, as seen from the earth, he completes the sidereal year, which contains 365 days 6 hours 9 minutes 14$\frac{1}{2}$ seconds. The sidereal year is therefore 20 minutes 17$\frac{1}{7}$ seconds longer than the solar or tropical year, and 9 minutes 14$\frac{1}{2}$ seconds longer than the Julian or the civil year, which we state at 365 days 6 hours, so that the civil year is almost a mean between the sidereal and tropical.

As the sun describes the whole ecliptic, or 360 degrees, in a tropical year, he moves 50′ 8″ of a degree every day at a mean rate; and consequently 50″ of a degree in 20 minutes 17$\frac{1}{7}$ seconds of time: therefore he will arrive at the same equinox or solstice when he is 50″ of a degree short of the same star or fixed point in the heavens from which he set out the year before. So that, with respect to the fixed stars, the sun and equinoctial points fall back (as it were) 30 degrees in 2160 years, which will make the stars appear to have gone 30 deg. forward with respect to the signs of the ecliptic in that time: for the same signs always keep in the same points of the ecliptic, without regard to the constellations.

348 Precession of the equinoxes explained. Fig. 181.

To explain this by a figure, let the sun be in conjunction with a fixed star at S, suppose in the 30th degree of ♉, at any given time. Then, making 2160 revolutions through the ecliptic VWX, at the end of so many sidereal years, he will be found again at S: but at the end of so many Julian years, he will be found at M, short of S: and at the end of so many tropical years he will be found short of M, in the 30th deg. of Taurus at T, which has receded back from S to T in that time, by the precession of the equinoctial points ♈ Aries and ♎ Libra. The arc ST will be equal to the amount of the precession of the equinox in 2160 years, at the rate of the 50″ of a degree, or 20 minutes 17$\frac{1}{7}$ seconds of time annually; this, in so many years, makes 30 days 10$\frac{1}{2}$ hours, which is the difference between 2160 sidereal and tropical years; and the arc MT will be equal to the space moved through by the sun in 2160 times 11 min. 8 sec. or 16 days 13 hours 48 minutes, which is the difference between 2160 Julian and tropical years.

349 Anticipation of the equinoxes explained.

The anticipation of the equinoxes, and consequently of the seasons, is by no means owing to the precession of the equinoctial and solstitial points in the heavens (which can only affect the apparent motions, places, and declinations, of the fixed stars), but to the difference between the civil and solar year, which is 11 minutes 3 seconds; the civil year containing 365 days 6 hours, and the solar year 365 days 5 hours 48 minutes 57 seconds.

The above 11 minutes 3 seconds, by which the civil or Julian year exceeds the solar, amounts to 11 days in 1433 years; and so much our seasons have fallen back with respect to the days of the months, since the time of the Nicene council in A. D. 325; and therefore, in order to bring back all the fasts and festivals to the days then settled, it was requisite to suppress 11 nominal days: and, that the same seasons might be kept to the same times of the year for the future, to leave out the bissextile-day in February at the end of every century of years not divisible by 4; reckoning them only common years, as the 17th, 18th, and 19th centuries, viz. the years 1700, 1800, 1900, &c. because a day intercalated every fourth year was too much; and retaining the bissextile-day at the end of those centuries of years which are divisible by 4, as the 16th, 20th, and 24th centuries, viz. the years 1600, 2000, 2400, &c. otherwise, in length of time, the seasons should be quite reversed with regard to the months of the year; though it would have required near 23,783 years to have brought about such a total change. If the earth had made exactly 365$\frac{1}{4}$ diurnal rotations on its axis, whilst it revolved from any equinoctial or solstitial point to the same again, the civil and solar years would always have kept pace together, and the style would never have needed any alteration.

Having thus mentioned the cause of the precession of the equinoctial points in the heavens, which occasions a slow deviation of the earth's axis from its parallelism, and thereby a change of the declination of the stars from the equator, together with a slow apparent motion of the stars forward with respect to the signs of the ecliptic, we shall now explain the phenomena by a diagram.

Let NZSVL be the earth, SONA its axis produced to the starry heavens, and terminating in A, the present north pole of the heavens, which is vertical to N the north pole of the earth. Let EOQ be the equator, T♋Z the tropic of Cancer, and VT ♑ the tropic of Capicorn; VOZ the ecliptic, and BO its axis, both which are immoveable among the stars. But as the equinoctial points recede in the ecliptic, the earth's Fig. 182.

axis

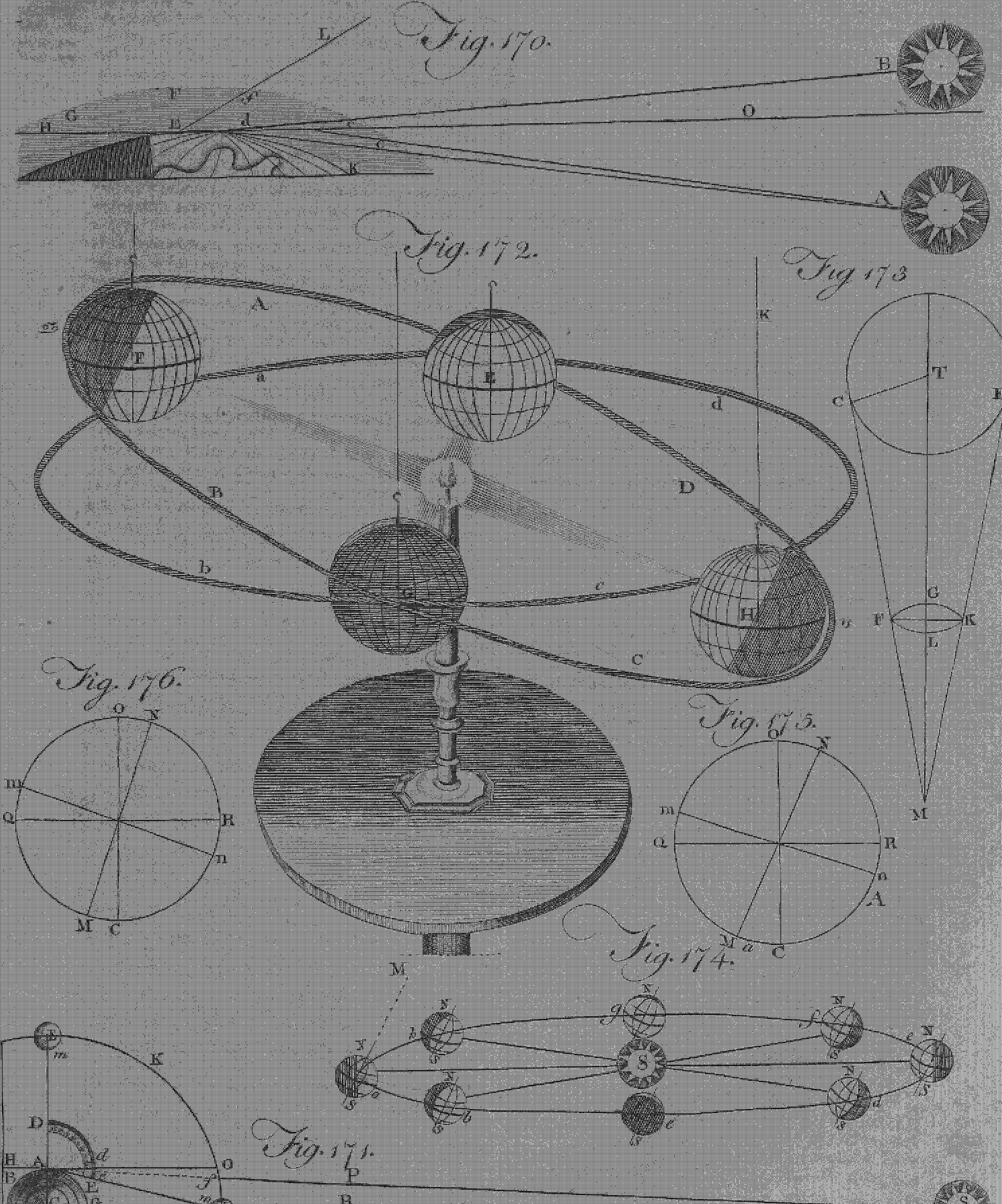
Fig. 170.
Fig. 171.
Fig. 172.
Fig. 173
Fig. 174.
Fig. 175.
Fig. 176.

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axis SON is in motion upon the earth's centre O, in such a manner as to describe the double cone NO*n* and SO*s*, round the axis of the ecliptic BO, in the time that the equinoctial points move quite round the ecliptic, which is 25,920 years; and in that length of time, the north pole of the earth's axis produced, describes the circle ABCDA in the starry heavens, round the pole of the ecliptic, which keeps immoveable in the centre of that circle. The earth's axis being $23\frac{1}{2}$ degrees inclined to the axis of the ecliptic, the circle ABCDA described by the north pole of the earth's axis produced to A, is 47 degrees in diameter, or double the inclination of the earth's axis. In consequence of this, the point A, which at present is the north pole of the heavens, and near to a star of the second magnitude in the tail of the constellation called the *Little Bear*, must be deserted by the earth's axis; which moving backwards a degree every 72 years, will be directed towards the star or point B in 6480 years hence; and in double of that time, or in 12,960 years, it will be directed towards the star or point C, which will then be the north pole of the heavens, although it is at present $8\frac{1}{2}$ degrees south of the zenith of London L. The present position of the equator EOQ will then be changed into *e*O*q*, the tropic of Cancer T ♋ Z; into V*t*♋, and the tropic of Capricorn VT ♑ into *t*♑ Z; as is evident by the figure. And the sun, in the same part of the heavens where he is now over the earthly tropic of Capricorn, and makes the shortest days and longest nights in the northern hemisphere, will then be over the earthly tropic of Cancer, and make the days longest and nights shortest. So that it will require 12,960 years yet more, or 25,920 from the then present time, to bring the north pole N quite round, so as to be directed toward that point of the heavens which is vertical to it at present. And then, and not till then, the same stars which at present describe the equator, tropics, and polar circles, &c. by the earth's diurnal motion, will describe them over again.

From the shifting of the equinoctial points, and with them all the signs of the ecliptic, it follows that those stars which in the infancy of astronomy were in Aries are now got into Taurus; those of Taurus into Gemini, &c. Hence likewise it is that the stars which rose or set at any particular season of the year, in the times of Hesiod, Eudoxus, Virgil, Pliny, &c. by no means answer at this time to their descriptions.

350 Of the moon.

The moon is not a planet, but only a satellite or attendant of the earth, going round the earth from change to change in 29 days 12 hours and 44 minutes, and round the sun with it every year. The moon's diameter is 2,180 miles; and her distance from the earth's centre is 240,000. She goes round her orbit in 27 days 7 hours 43 minutes, moving about 2290 miles every hour; and turns round her axis exactly in the time that she goes round the earth, which is the reason of her keeping always the same side towards us, and that her day and night taken together is as long as our lunar month.

351 Reflects the sun's light.

The moon is an opaque globe like the earth, and shines only by reflecting the light of the sun: therefore, whilst that half of her which is towards the sun is enlightened, the other half must be dark and invisible. Hence she disappears when she comes between us and the sun; because her dark side is then towards us. When she is gone a little way forward, we see a little of her enlightened side: which still increases to our view as she advances forward, until she comes to be opposite to the sun; and then her whole enlightened side is towards the earth, and she appears with a round illumined orb, which we call the *full moon*; her dark side being then turned away from the earth. From the full she seems to decrease gradually as she goes through the other half of her course; showing us less and less of her enlightened side every day, till her next change or conjunction with the sun, and then she disappears as before.

The moon has scarce any difference of seasons: her axis being almost perpendicular to the ecliptic. What is very singular, one half of her has no darkness at all; the earth constantly affording it a strong light in the sun's absence; while the other half has a fortnight's darkness and a fortnight's light by turns.

352 Earth appears a moon to our moon.

Our earth is thought to be a moon to the moon; waxing and waning regularly, but appearing 13 times as big, and affording her 13 times as much light as she does us. When she changes to us, the earth appears full to her: and when she is in her first quarter to us, the earth is in its third quarter to her; and *vice versa*.

But from one half of the moon the earth is never seen at all: from the middle of the other half, it is always seen over head; turning round almost 30 times as quick as the moon does. From the circle which limits our view of the moon, only one half of the earth's side next her is seen; the other half being hid below the horizon of all places on that circle. To her the earth seems to be the biggest body in the universe; for it appears 13 times as big as she does to us.

As the earth turns round its axis, the several continents, seas, and islands, appear to the moon's inhabitants like so many spots of different forms and brightness, moving over its surface; but much fainter at some times than others, as our clouds cover them or leave them. By these spots the Lunarians can determine the time of the earth's diurnal motion, just as we do the motion of the sun: and perhaps they measure their time by the motion of the earth's spots; for they cannot have a truer dial.

353 How the Lunar inhabitants can measure their year.

The moon's axis is so nearly perpendicular to the ecliptic, that the sun never removes sensibly from her equator; and the obliquity of her orbit, which is next to nothing as seen from the sun, cannot cause the sun to decline sensibly from her equator. Yet her inhabitants are not destitute of means for ascertaining the length of their year, though their method and ours must differ. For we can know the length of our year by the return of our equinoxes; but the Lunarians, having always equal day and night, must have recourse to another method: and we may suppose, they measure their year by observing when either of the poles of our earth begins to be enlightened and the other to disappear, which is always at our equinoxes; they being conveniently situated for observing great tracts of land about our earth's poles, which are entirely unknown to us. Hence we may conclude, that the year is of the same absolute length both to the earth and the moon, though very different as to the number of days: we having $365\frac{1}{4}$ natural days, and the Lunarians only $12\frac{7}{19}$, every day and night in the moon being as long as $29\frac{1}{2}$ on the earth.

The moon's inhabitants on the side next the earth

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may as easily find the longitude of their places as we can find the latitude of ours. For the earth keeping constantly, or very nearly so, over one meridian of the moon, the east or west distances of places from that meridian are as easily found as we can find our distance from the equator by the altitude of our celestial poles.

354 Longitude easily found.

As the sun can only enlighten that half of the earth which is at any moment turned towards him, and, being withdrawn from the opposite half, leaves it in darkness; so he likewise doth to the moon: only with this difference, that as the earth is surrounded by an atmosphere, we have twilight after the sun sets; but if the moon has none of her own, nor is included in that of the earth, the lunar inhabitants have an immediate transition from the brightest sun-shine to the blackest darkness. For, let t r k s w be the earth, and A, B, C, D, E, F, G, H, the moon in eight different parts of her orbit. (Fig. 183.) As the earth turns round its axis from west to east, when any place comes to t, the twilight begins there, and when it revolves from thence to r the sun S rises; when the place comes to s the sun sets, and when it comes to w the twilight ends. But as the moon turns round her axis, which is only once a month, the moment that any point of her surface comes to *r* (see the moon at G), the sun rises there without any previous warning by twilight; and when the same point comes to *s* the sun sets, and that point goes into darkness as black as at midnight.

355 Her phases explained.

The moon being an opaque spherical body (for her hills take off no more from her roundness than the inequalities on the surface of an orange takes off from its roundness), we can only see that part of the enlightened half of her which is towards the earth. And therefore, when the moon is at A, in conjunction with the sun S, her dark half is towards the earth, and she disappears, as at *a*, there being no light on that half to render it visible. When she comes to her first octant at B, or has gone an eighth part of her orbit from her conjunction, a quarter of her enlightened side is towards the earth, and she appears horned, as at *b*. When she has gone a quarter of her orbit from between the earth and sun to C, she shows us one half of her enlightened side, as at *c*, and we say she is a quarter old. At D, she is in her second octant; and by showing us more of her enlightened side she appears gibbous, as at *d*. At E, her whole enlightened side is towards the earth; and therefore she appears round, as at *e*; when we say it is full moon. In her third octant at F, part of her dark side being towards the earth, she again appears gibbous, and is on the decrease, as at *f*. At G, we see just one half of her enlightened side; and she appears half decreased, or in her third quarter, as at *g*. At H, we only see a quarter of her enlightened side, being in her fourth octant; where she appears horned, as at *h*. And at A, having completed her course from the sun to the sun again, she disappears; and we say it is new moon. Thus, in going from A to E, the moon seems continually to increase; and in going from E to A, to decrease in the same proportion; having like phases at equal distances from A to E, but as seen from the sun S she is always full.

356 Never appears perfectly round.

The moon appears not perfectly round when she is full in the highest or lowest part of her orbit, because we have not a full view of her enlightened side at that time. When full in the highest part of her orbit, a small deficiency appears on her lower edge; and the contrary when full in the lowest part of her orbit.

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It is plain by the figure, that when the moon changes to the earth, the earth appears full to the moon; and *vice versa*. For when the moon is at A, new to the earth, the whole enlightened side of the earth is towards the moon; and when the moon is at E, full to the earth, its dark side is towards her. Hence a new moon answers to a full earth, and a full moon to a new earth. The quarters are also reversed to each other.

357 Agreeable representation of her phases.

Between the third quarter and change, the moon is frequently visible in the forenoon, even when the sun shines; and then she affords us an opportunity of seeing a very agreeable appearance, wherever we find a globular stone above the level of the eye, as suppose on the top of a gate. For, if the sun shines on the stone, and we place ourselves so as the upper part of the stone may just seem to touch the point of the moon's lowermost horn, we shall then see the enlightened part of the stone exactly of the same shape with the moon; horned as she is, and inclined the same way to the horizon. The reason is plain: for the sun enlightens the stone the same way as he does the moon: and both being globes, when we put ourselves into the above situation, the moon and stone have the same position to our eyes; and therefore we must see as much of the illuminated part of the one as of the other.

The position of the moon's cusps, or a right line touching the points of her horns, is very differently inclined to the horizon at different hours of the same days of her age. Sometimes she stands, as it were, upright on her lower horn, and then such a line is perpendicular to the horizon: when this happens, she is in what the astronomers call *the nonagesimal degree*; which is the highest point of the ecliptic above the horizon at that time, and is 90 degrees from both sides of the horizon where it is then cut by the ecliptic. But this never happens when the moon is on the meridian, except when she is at the very beginning of Cancer or Capricorn. 358

358 Nonagesimal degree.

That the moon turns round her axis in the time that she goes round her orbit, is quite demonstrable; for, a spectator at rest, without the periphery of the moon's orbit, would see all her sides turned regularly towards him in that time. She turns round her axis from any star to the same star again in 27 days 8 hours; from the sun to the sun again in $29\frac{1}{2}$ days: the former is the length of the sidereal day, and the latter the length of her solar day. A body moving round the sun would have a solar day in every revolution, without turning on its axis; the same as if it had kept all the while at rest, and the sun moved round it: but without turning round its axis it could never have one sidereal day, because it would always keep the same side towards any given star.

If the earth had no annual motion, the moon would go round it so as to complete a lunation, a sidereal, and a solar day, all in the same time. But, because the earth goes forward in its orbit while the moon goes round the earth in her orbit, the moon must go as much more than round her orbit from change to change

in

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in completing a solar day, as the earth has gone forward in its orbit during that time, i. e. almost a twelfth part of a circle.

359 Delineation of her path round the sun.

If the earth had no annual motion, the moon's motion round the earth, and her track in open space, would be always the same (c). But as the earth and moon move round the sun, the moon's real path in the heavens is very different from her visible path round the earth; the latter being in a progressive circle, and the former in a curve of different degrees of concavity, which would always be the same in the same parts of the heavens, if the moon performed a complete number of lunations in a year without any fraction.

Let a nail in the end of the axle of a chariot-wheel represent the earth, and a pin in the nave the moon; if the body of the chariot be propped up so as to keep that wheel from touching the ground, and the wheel be then turned round by hand, the pin will describe a circle both round the nail and in the space it moves through. But if the props be taken away, the horses put to, and the chariot driven over a piece of ground which is circularly convex; the nail in the axle will describe a circular curve, and the pin in the nave will still describe a circle round the progressive nail in the axle, but not in the space through which it moves. In this case, the curve described by the nail will resemble in miniature as much of the earth's annual path round the sun, as it describes whilst the moon goes as often round the earth as the pin does round the nail: and the curve described by the pin will have some resemblance of the moon's path during so many lunations.

Fig. 184.

Let us now suppose that the radius of the circular curve described by the nail in the axle is to the radius of the circle which the pin in the nave describes round the axle, as 337½ to 1; (D) which is the proportion of the radius or semidiameter of the earth's orbit to that of the moon's, or of the circular curve A 1 2 3 4 5 6 7 B, &c. to the little circle *a*; and then, whilst the progressive nail describes the said curve from A to E, the pin will go once round the nail with regard to the centre of its path, and in so doing will describe the curve *a b c d e*. The former will be a true representation of the earth's path for one lunation, and the latter of the moon's for that time. Here we may set aside the inequalities of the moon's motion, and also the earth's moving round its common centre of gravity and the moon's: all which, if they were truly copied in this experiment, would not sensibly alter the figure of the paths described by the nail and pin, even though they should rub against a plain upright surface all the way, and leave their tracts visible upon it. And if the chariot was driven forward on such a convex piece of ground, so as to turn the wheel several times round, the track of the pin in the nave would still be concave towards the centre of the circular curve described by the nail in the axle; as the moon's path is always concave to the sun in the centre of the earth's annual orbit.

In this diagram, the thickest curve line ABCDE, with the numeral figures set to it, represents as much of the earth's annual orbit as it describes in 32 days from west to east; the little circles at A, B, C, D, E, show the moon's orbit in due proportion to the earth's; and the smallest curve *a* C *f* represents the line of the moon's path in the heavens for 32 days, accounted from any particular new moon at *a*. The sun is supposed to be in the centre of the curve A 1 2 3 4 5 6 7 B, &c. and the small dotted circles upon it represent the moon's orbit, of which the radius is in the same proportion to the earth's path in this scheme, that the radius of the moon's orbit in the heavens was supposed to bear to the radius of the earth's annual path round the sun; that is, as 240,000, to 81,000,000, or as 1 to 337½.

When the earth is at A, the new moon is at *a*; and in the seven days that the earth describes the curve 1 2 3 4 5 6 7, the moon in accompanying the earth describes the curve *a b*; and is in her first quarter at *b* when the earth is at B. As the earth describes the curve B 8 9 10 11 12 13 14, the moon describes the curve *b c*; and is at *c*, opposite to the sun, when the earth is at C. Whilst the earth describes the curve C 15 16 17 18 19 20 21 22, the moon describes the curve *c d*; and is in her third quarter at *d* when the earth is at D. And lastly, whilst the earth describes the curve D 23 24 25 26 27 28 29, the moon describes the curve *d e*; and is again in conjunction at *e* with the sun when the earth is at E, between the 29th and 30th day of the moon's age, accounted by the numeral figures from the new moon at A. In describing the curve *a* C *e*, the moon goes round the progressive earth as really as if she had kept in the dotted circle A, and the earth continued immoveable in the centre of that circle.

360 Her path always concave to the sun.

And thus we see, that although the moon goes round the earth in a circle, with respect to the earth's centre, her real path in the heavens is not very different in appearance from the earth's path. To show that the moon's path is concave to the sun, even at the time of change, it is carried on a little farther into a second lunation as to *f*.

Fig. 185.

The curves which Jupiter's satellites describe, are all of different sorts from the path described by our moon, although these satellites go round Jupiter as the moon goes round the earth. Let ABCDE, &c. be as much of Jupiter's orbit as he describes in 18 days from A to T; and the curves *a*, *b*, *c*, *d*, will be the paths of his four moons going round him in his progressive motion. Now let us suppose all these moons to set out from a conjunction with the sun, as seen from Jupiter at A; then, his first or nearest moon will be at *a*, his second at *b*, his third at *c*, and his fourth at *d*. At the end of 24 terrestrial hours after this con-

(c) In this place, we may consider the orbits of all the satellites as circular, with respect to their primary planets; because the eccentricities of their orbits are too small to affect the phenomena here described.

(D) The figure by which this is illustrated is borrowed from Mr Ferguson. Later observations have determined the proportions to be different: but we cannot find that any delineation of this kind hath been given by astronomers, according to the new proportions.

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conjunction, Jupiter has moved to B, his first moon or satellite has described the curve *a* 1, his second the curve *b* 1, his third *c* 1, and his fourth *d* 1. The next day, when Jupiter is at C, his first satellite has described the curve *a* 2, from its conjunction, his second the curve *b* 2, his third the curve *c* 2, and his fourth the curve *d* 2, and so on. The numeral figures under the capital letters show Jupiter's place in his path every day for 18 days, accounted from A to T; and the like figures set to the paths of his satellites, show where they are at the like times. The first satellite, almost under C, is stationary at + as seen from the sun, and retrograde from + to 2: at 2 it appears stationary again, and thence it moves forward until it has past 3, and is twice stationary and once retrograde between 3 and 4. The path of this satellite intersects itself every $42\frac{1}{2}$ hours, making such loops as in the diagram at 2. 3. 5. 9. 10. 12. 14. 16. 18. a little after every conjunction. The second satellite *b*, moving slower, barely crosses its path every 3 days 13 hours; as at 4. 7. 11. 14. 18, making only five loops and as many conjunctions in the time that the first makes ten. The third satellite *c* moving still slower, and having described the curve *c* 1. 2. 3. 4. 5. 6. 7. comes to an angle at 7 in conjunction with the sun at the end of 7 days 4 hours; and so goes on to describe such another curve 7. 8. 9. 10. 11. 12. 13. 14. and is at 14 in its next conjunction. The fourth satellite *d* is always progressive, making neither loops nor angles in the heavens; but comes to its next conjunction at *e* between the numeral figures 16 and 17, or in 16 days 18 hours.

The method used by Mr Ferguson to delineate the paths of these satellites was the following. Having drawn their orbits on a card, in proportion to their relative distances from Jupiter, he measured the radius of the orbit of the fourth satellite, which was an inch and $\frac{14}{100}$ parts of an inch; then multiplied this by 424 for the radius of Jupiter's orbit, because Jupiter is 424 times as far from the sun's centre as his fourth satellite is from his centre; and the product thence arising was $483\frac{36}{100}$ inches. Then taking a small cord of this length, and fixing one end of it to the floor of a long room by a nail, with a black-lead pencil at the other end, he drew the curve ABCD, &c. and set off a degree and half thereon from A to T; because Jupiter moves only so much, whilst his outermost satellite goes once round him, and somewhat more; so that this small portion of so large a circle differs but very little from a straight line. This done, he divided the space AT into 18 equal parts, as AB, BC, &c. for the daily progress of Jupiter; and each part into 24 for his hourly progress. The orbit of each satellite was also divided into as many equal parts as the satellite is hours in finishing its synodical period round Jupiter. Then drawing a right line through the centre of the card, as a diameter to all the four orbits upon it, he put the card upon the line of Jupiter's motion, and transferred it to every horary division thereon, keeping always the said diameter-line on the line of Jupiter's path; and running a pin through each horary division in the orbit of each satellite as the card was gradually transferred along the line ABCD, &c. of Jupiter's motion, he marked points for every hour through the card for the curves described by the satellites, as the primary planet in the centre of the card was carried forward on the line; and so finished the figure, by drawing the lines of each satellite's motion through those (almost innumerable) points: by which means, this is perhaps as true a figure of the paths of the satellites as can be desired. And in the same manner might those of Saturn's satellites be delineated.

It appears by the scheme, that the three first satellites come almost into the same line or position every seventh day; the first being only a little behind with the second, and the second behind with the third. But the period of the fourth satellite is so incommensurate to the periods of the other three, that it cannot be guessed at by the diagram when it would fall again into a line of conjunction with them, between Jupiter and the sun. And no wonder; for supposing them all to have been once in conjunction, it will require 3,087,043,493,260 years to bring them in conjunction again.

The moon's absolute motion from her change to her first quarter, or from *a* to *b*, is so much slower than the earth's that she falls 240,000 miles (equal to the semidiameter of her orbit) behind the earth at her first quarter in *b*, when the earth is in B; that is, she falls back a space equal to her distance from the earth. From that time her motion is gradually accelerated to her opposition or full at *c*; and then she is come up as far as the earth, having regained what she lost in her first quarter from *a* to *b*. From the full to the last quarter at *d*, her motion continues accelerated so as to be just as far before the earth at *d* as she was behind it at her first quarter in *b*. But from *d* to *e* her motion is retarded so, that she loses as much with respect to the earth as is equal to her distance from it, or to the semidiameter of her orbit; and by that means she comes to *e*, and is then in conjunction with the sun as seen from the earth at E. Hence we find, that the moon's absolute motion is slower than the earth's from her third quarter to her first, and swifter than the earth's from her first quarter to her third; her path being less curved than the earth's in the former case and more in the latter. Yet it is still bent the same way towards the sun; for if we imagine the concavity of the earth's orbit to be measured by the length of a perpendicular line G *g*, let down from the earth's place upon the straight line *b g d* at the full of the moon, and connecting the places of the earth at the end of the moon's first and third quarters, that length will be about 640,000 miles; and the moon when new only approaching nearer to the sun by 240,000 miles than the earth is, the length of the perpendicular let down from her place at that time upon the same straight line, and which shows the concavity of that part of her path, will be about 400,000 miles.

561
A difficulty concerning attraction solved.

The moon's path being concave to the sun throughout, demonstrates that her gravity towards the sun, at her conjunction, exceeds her gravity towards the earth; and if we consider that the quantity of matter in the sun is vastly greater than the quantity of matter in the earth, and that the attraction of each body diminishes as the square of the distance from it increases, we shall soon find, that the point of equal attraction between the earth and the sun, is much nearer the earth than the moon is at her change. It may then appear surprising that the moon does not abandon the earth when

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when she is between it and the sun, because she is considerably more attracted by the sun than by the earth at that time. But this difficulty vanishes when we consider, that a common impulse on any system of bodies affects not their relative motions; but that they will continue to attract, impel, or circulate round one another, in the same manner as if there was no such impulse. The moon is so near the earth, and both of them so far from the sun, that the attractive power of the sun may be considered as equal on both; and therefore the moon will continue to circulate round the earth in the same manner as if the sun did not attract them at all: like bodies in the cabin of a ship, which may move round or impel one another in the same manner when the ship is under sail as when it is at rest; because they are all equally affected by the common motion of the ship. If by any other cause, such as the near approach of a comet, the moon's distance from the earth should happen to be so much increased, that the difference of their gravitating forces towards the sun should exceed that of the moon towards the earth; in that case, the moon, when in conjunction, would abandon the earth, and be either drawn into the sun, or comet, or circulate round about it.

The ruggedness of the moon's surface mentioned n° 146, 147. is of great use to us, by reflecting the sun's light to all sides: for if the moon were smooth and polished like a looking-glass, or covered with water, she could never distribute the sun's light all round; only in some positions she would show us his image, no bigger than a point, but with such a lustre as would be hurtful to our eyes.

362
Why her edge appears always even.

The moon's surface being so uneven, many have wondered why her edge appears not jagged, as well as the curve bounding the light and dark places. But if we consider, that what we call the *edge* of the moon's disk is not a single line set round with mountains, in which case it would appear irregularly indented, but a large zone having many mountains lying behind one another from the observer's eye, we shall find that the mountains in some rows will be opposite to the vales in others; and so fill up the inequalities as to make her appear quite round: just as when one looks at an orange, although its roughness be very discernible on the side next the eye, especially if the sun or a candle shines obliquely upon that side, yet the line terminating the visible part still appears smooth and even.

Having said thus much of the moon's Period, Phases, Path, &c. it may not be amiss to describe, in a summary manner, the irregularities of her motion; and though these have been already treated of on the principles of the Newtonian system, yet as the subject has much embarrassed the astronomical world, it is hoped, that the following explanation of the planetary irregularities upon common mechanical principles, from Mr Nicholson's Natural Philosophy, may not appear superfluous to uninformed readers.

Philadelphia Edition, 184 et seq.

"If the sun were at rest, and the planets did not mutually gravitate towards each other, they would describe ellipses, having the sun in the common focus: But since they mutually act on the sun and on each other, it must follow that the sun is perpetually moved about the centre of gravity of all the planets; which centre is the common focus of all their orbits. This centre, by reason of the sun's very great bulk, can in no situation exceed the distance of its semidiameter from its surface. Some small irregularities arise from these mutual actions, but much less would ensue if the sun were at rest, or not subject to the reaction of the other planets. The irregularities in the motions of the primary planets are scarcely considerable enough to come under observation in the course of many revolutions; but those of the moon are very perceptible on account of its nearness to us, and from other causes. It will therefore be sufficient to explain the latter, and apply the explanation to the former, being effects of the same kind.

"If the actions of the sun upon the earth and moon were equal upon each, according to their masses, and tended to produce motions in parallel directions, their relative motions would be the same as if no such force acted upon them. But these forces vary both in quantity and direction according to the various relative situations of the earth and moon.

"Let the point S (fig. 162) represent the sun, and ADBC the orbit of the moon. Then if the moon be at the quadrature A, the distances ES and AS of the earth and moon from the sun being equal, their gravities towards S will also be equal, and may be represented by those lines ES and AS. Draw the line A parallel and equal to ES, and join LS, which will be parallel to AE. The force AS may be resolved (from *principles of compound motion*) into the two forces AL and AE; of which AL, by reason of its parallelism and equality to ES, will not disturb their relative motions or situation: but the force AE conspiring with that of gravity, will cause the moon to fall farther below the tangent of its orbit than it would have done if no such disturbing force had existed. Therefore, at or near the quadratures, the moon's gravity towards the earth is increased more than according to the regular course, and its orbit is rendered more curve.

"When the moon is at the conjunction C, the distances ES and CS not being equal, the moon's gravitation towards the sun exceeds that of the earth in the same proportion as the square of ES exceeds the square of CS. And because the excess acts contrary to the direction of the moon's gravity towards the earth, it diminishes the effect thereof, and causes the moon to fall less below the tangent of its orbit than it would if no such disturbing force existed. A like and very nearly equal effect follows, when the moon is at the opposition D, by the earth's gravitation towards the sun being greater than that of the moon; whence their mutual gravitation is diminished as in the former case. Therefore, at or near the conjunction or opposition, the moon's gravity is diminished, and its orbit rendered less curve.

"It is found that the force added to the moon's gravity at the quadratures, is to the gravity with which it would revolve about the earth in a circle, at its present mean distance, if the sun had no effect on its motion, as 1 to 190; and that the force subducted from its gravity at the conjunction or opposition is about double this quantity. The influence of the sun, then, on the whole, increases the moon's distance from the earth, and augments its periodical time: and since this influence is most considerable when the earth is nearest the sun, or in its perihelium, its periodical time must then be the greatest;" and it is so found by observation.

"To

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"To show the effect of the sun in disturbing the moon's motion at any situation between the conjunction and one of the quadratures, suppose at M, let ES represent the earth's gravity towards the sun, draw the line MS, which continue towards G; from M set off MG, so that MG may be to ES as the square of the earth's distance ES is to the square of the moon's distance MS; and MG will represent the moon's gravity towards the sun. From M draw MF parallel and equal to ES; join FG, and draw MH parallel and equal to FG. The force MG may be resolved into MF and MH; of which MF, by reason of its parallelism and equality to ES, will not disturb the relative motions or situations of the moon and earth: MH then is the disturbing force. Draw the tangent MK to the moon's orbit, and continue the radius EM towards I; draw HI parallel to KM, and intersecting MI in I, and complete the parallelogram by drawing HK parallel to IM, and intersecting MK in K. The force MH may be resolved into MI and MK; of which MI affects the gravity, and MK the velocity, of the moon. When the force MH coincides with the tangent, that is, when the moon is 35° 16′ distant from the quadrature, the force MI which affects the gravity, vanishes; and when the force MH coincides with the radius, that is, when the moon is either in the conjunction or quadrature, the force MK vanishes. Between the quadrature and the distance of 35° 16′ from it, the line or force MH falls within the tangent, and consequently the force MI is directed towards E, and the moon's gravity is increased: but, at any greater distance from the quadrature, the line MH falls without the tangent, and the force MI is directed from E, the moon's gravity being diminished. It is evident that the force MK is always directed to some point in the line which passes through the sun and earth; therefore it will accelerate the moon's motion while it is approaching towards that line, or the conjunction, and similarly retard it as it recedes from it, or approaches towards the quadrature, by conspiring with the motion in one case, and subducting from it in the other.

"As the moon's gravity towards the sun, at the conjunction, is diminished by a quantity which is as the difference of the squares of their distances; and as this difference, on account of the very great distance of the sun, is nearly the same when the moon is at the opposition, the mutual tendency to separate, or diminution of gravity, will be very nearly the same. Whence it easily follows, that all the irregularities which have been explained as happening between the quadratures and conjunction, must, in like circumstances, take place between the quadratures and opposition.

"If the moon revolved about the earth in a circular orbit, the sun's disturbing influence being supposed not to act, then this influence being supposed to act would convert the orbit into an ellipsis. For the increase of gravity renders it more curve at the quadratures, by causing the moon to fall further below the tangent; and the diminution of gravity, as well as the increased velocity, render the orbit less curve at the conjunction and opposition, by causing the moon to fall less below the tangent in a given time. Therefore, an ellipsis would be described whose less or more convex parts would be at the quadratures, and whose longest diameter would pass through them: Consequently the moon would be farthest from the earth at the quadratures, and nearest at the conjunction and opposition. Neither is it strange that the moon should approach or come nearer to the earth at the time when its gravity is the least, since that approach is not the immediate consequence of the decrease of gravity, but of the curvity of its orbit near the quadratures; and in like manner, its recess from the earth does not arise immediately from its diminished gravity, from the velocity and direction acquired at the conjunction or opposition. But as the moon's orbit is, independent of the sun's action, an ellipsis, then effects take place only as far as circumstances permit. The moon's gravity towards the earth being thus subject to a continual change in its ratio, its orbit is of no constant form. The law of its gravity being nearly in the inverse proportion of the squares of the distances, its orbit is nearly a quiescent ellipsis; but the deviation from this law occasions its apsides to move direct or retrograde, according as those deviations are in defect or in excess. Astronomers, to reduce the motion of the apsides to computation, suppose the revolving body to move in an ellipsis, whose transverse diameter, or line of the apsides, revolves at the same time about the focus of the orbit. When the moon is in the conjunction or opposition, the sun subducts from its gravity, and that the more the greater its distance is from the earth; so that its gravity follows a greater proportion than the inverted ratio of the square of the distance, and consequently the apsides of its orbit must then move in consequentia or direct. In the quadratures the sun adds to the moon's gravity; and that the more the greater its distance is from the earth: so that its gravity follows a less proportion than the inverted ratio of the square of her distance, and consequently the apsides of its orbit must then move in antecedentia or retrograde. But because the action of the sun subducts more from the moon's gravity in the conjunction and opposition than it adds to it in the quadratures, the direct motion exceeds the retrograde, and at the end of each revolution the apsides are found to be advanced according to the order of the signs.

"If the plane of the moon's orbit coincided with that of the ecliptic, these would be the only irregularities arising from the sun's action; but because it is inclined to the plane of the ecliptic in an angle of about 5 degrees, the whole disturbing force does not act upon the moon's motion in its orbit; a small part of the force being employed to draw it out of the plane of the orbit into that of the ecliptic.

"Of the forces MK and MI (fig. 162.) which disturb the moon's motion, MI, being always in the direction of the radius, can have no effect in drawing it out of the plane of its orbit: and if the force MK really coincided with the tangent, as we, neglecting the small deviation arising from the obliquity of the moon's orbit, have hitherto supposed, it is evident that its only effect would be that of accelerating or retarding the moon's motion, without affecting the plane of its orbit: But because that force is always directed to some point in the line which passes through the centres of the sun and earth, it is evident that it can coincide with the tangent only when that line is in the plane of the moon's orbit; that is to say, when the nodes are in the conjunction and opposition. At all other times

times the force MK must decline to the northward or southward of the tangent, and, compounding itself with the moon's motion, will not only accelerate or retard it, according to the circumstances before explained, but will likewise alter its direction, deflecting it towards that side of the orbit on which the point, the force MK, tends to is situated. This deflection causes the moon to arrive at the ecliptic either sooner or later than it would otherwise have done; or, in other words, it occasions the intersection of its orbit with the ecliptic to happen in a point of the ecliptic, either nearer to or farther from the moon, than that in which it would have happened if such deflection had not taken place.

"To illustrate this, let the elliptical projection COQN (fig. 163.) represent a circle in the plane of the ecliptic, MOPN the moon's orbit intersecting the ecliptic in the nodes N and O. Suppose the moon to be in the northern part of its orbit at M and moving towards the node O; the disturbing force MK, which tends towards a point in the line SE to the southward of the tangent MT, will be compounded with the tangental force, and will cause the moon to describe the arc Mm, to which MR is tangent, instead of the arc MO; whence the node O is said to be moved to m. In this manner the motion of the nodes may be explained for any other situation.

"This motion evidently depends on a twofold circumstance; namely, the quantity and direction of the force MK. If the force MK be increased, its direction remaining the same, it will deflect the curve of the moon's path from its orbit in a greater degree; and, on the other hand, if its direction be altered so as to approach nearer to a right angle with the tangent, it will cause a greater deflection, though its quantity remain the same. When the moon is in the quadratures, the force MK vanishes, consequently the nodes are then stationary. When the moon is at the octant, or 45 degrees from the quadrature, the force MK is the greatest of all; and therefore the motion of the nodes is then most considerable, as far as it depends on the quantity of MK: But the direction of this force in like circumstances depends on the situation of the line of the nodes. If the line of the nodes coincides with the line passing through the centres of the sun and earth, the force MK coincides with the tangent of the moon's orbit, and the nodes are stationary; and the farther the node is removed from that line, the farther is that line removed from the plane of the moon's orbit, till the line of the nodes is in the quadratures; at which time the line passing through the centres of the sun and earth, makes an angle with the plane of the moon's orbit equal to its whole inclination, or 5 degrees; consequently the angle formed between MK and the tangent, in like circumstances, is then greatest, MK being directed to a point in a line which is further from the plane of the moon's orbit than at any other time, and of course the motion of the nodes is then most considerable.

"To determine the quantity and direction of the motion of the nodes, suppose the moon in the quarter preceding the conjunction, and the node towards which it is moving to be between it and the conjunction; in this case its motion is directed to a point in the ecliptic which is less distant than the point towards which the force MK is directed: the force MK then compounding with the moon's motion, causes it to be directed to a point more distant than it would otherwise have been; that is to say, the node towards which the moon moves is moved towards the conjunction. When the moon has passed the node, its course is directed to the other node, which is a point in the ecliptic more distant than the point to which MK is directed, and therefore MK compounding with its motion causes it to be directed to a point less distant than it would otherwise have been; so that in this case, likewise, the ensuing node is moved towards the conjunction. After the moon has passed the conjunction, the force MK still continues to deflect its course towards the ecliptic; and consequently the motion of the node is the same way till its arrival at the quadrature. Suppose, again, the moon to be at the conjunction, and the node towards which it is moving to be between it and the quadrature; in this case, the force MK compounding with the moon's motion, causes it to move towards a point in the ecliptic less distant than it would otherwise have done; so that the ensuing node is brought towards the conjunction.

"When the moon has passed the node, the force MK still continuing to deflect its course towards the same side of its orbit, produces a contrary effect; namely, as it before occasioned it to converge to the ecliptic, so it now causes it to diverge from it; and its motion, in consequence, tends continually to a point in the ecliptic more distant than it would otherwise have done; the ensuing node in this instance being also brought towards the conjunction.

"As the disturbing forces are very nearly the same in the half of the moon's orbit which is farthest from the sun, this last paragraph is true when it moves in that part of its orbit, if the word *opposition* be every where inserted instead of the word *conjunction*.

"Whence it is easy to deduce this general rule: That when the moon is in the part of its orbit nearest the sun, the node towards which it is moving is made to move towards the conjunction; and when it is in the part of its orbit farthest from the sun, the node towards which it is moving is made to move towards the opposition.

"Suppose the moon at Q (fig. 176.), or the quadrature preceding the conjunction, then the ensuing node, if at 90° distance, or at the conjunction C, will be stationary (as before observed); but if it be at a greater or less distance it will be brought towards C. Thus, if the nodes be in the position MN, the ensuing node M, being at a less distance from Q than 90°, will move towards C, or direct, while the moon moves through the arc QM; after which N becomes the ensuing node and likewise moves towards the conjunction C, or retrograde during the moon's motion through the arc MR; and because the arc MR exceeds QM, the retrograde motion exceeds the direct. Again, if the nodes be in the position *nm*, the ensuing node *n* being at a greater distance from Q than 90°, will move towards C, or retrograde during the moon's motion through the arc Q*n*; after which the node *m* becomes the ensuing node, and likewise moves towards the conjunction C, or direct, during the moon's motion through the arc *n*R; and because the arc Q*n* exceeds NR, the retrograde motion here also exceeds the

Particular Explication of the Celestial Phenomena.

the direct. If the nodes be in the quadratures QR, the ensuing node R removes towards C, or retrograde, during the moon's motion through the arc QR, or almost the whole semiorbit. The same may be shown in the other half of the orbit ROQ with respect to the opposition O; and therefore in every revolution of the moon, the retrograde motion of the nodes exceeds the direct; and, on the whole, the nodes are carried round contrary to the order of the signs.

"The line of the conjunction is by the earth's annual motion brought into every possible situation with respect to the nodes in the course of a year, independent of their own proper motion; which last occasions the change of situation to be performed in about nineteen days less.

"The inclination of the moon's orbit being the angle which its course makes with the plane of the ecliptic, it is evident from what has been said, that this angle is almost continually changing. Suppose the line of the nodes, by its retrograde motion, to leave the conjunction C (fig. 175.) and become in the second and fourth quarters as in the position MN, and the moon to move from the node M to the node N; then, because the ensuing node N moves towards the conjunction C, while the moon is in the nearer half of its orbit, the moon's course must be continually more and more inflected towards the ecliptic till its arrival at R. This inflection in the first 90°, or MA from M, prevents its diverging so much from the ecliptic, as it would otherwise have done; that is to say, it diminishes the angle of the moon's inclination. From A to R its course begins to converge towards the ecliptic; and this convergence is increased by the inflection which, in the preceding 90°, prevented its divergence: in the arc AR, then, their inclination is increased. During the moon's motion from R to N, the node is moved towards the opposition O, and consequently the angle of its course to N, is rendered less than it would have been if the node has not moved; or, in other words, the inclination is diminished. And because the arc MA added to the arc RN is greater than the arc AR, the inclination at the subsequent node is less than at the precedent node; and the same may be shown in the other half revolution NQM.

"Therefore, while the nodes are moving from the conjunction and opposition to the quadratures, the inclination of the moon's orbit on the whole diminishes in every revolution till they arrive in the quadratures, at which time it is least of all. When the line of the nodes has passed the quadratures, and is in the first and third quarters, as in the position *mn*, it is easily shown by the same kind of argument, that the inclination is increased while the moon passes from *m* to Q, then diminishes for the remainder of the first 90°, or Q*a*, and is afterwards increased for the other 90°, or *an*; and the same may be proved for the other half revolution *n*R*m*. Consequently, while the nodes are moving from the quadratures to the conjunction and opposition, the inclination is increased by the same degrees as it before was diminished, till they arrive at the conjunction and opposition; at which time it returns to its first quantity, being then greatest of all.

"The line of the nodes in the course of one entire revolution with respect to the sun, is twice in the quadratures and twice in the conjunction and opposition. Therefore the inclination of the moon's orbit to the ecliptic is diminished and increased by turns twice in every revolution of the nodes.

"All the irregularities of the moon's motion are a little greater when in the half of its orbit nearest the sun, than when it is in the other half; the chief reason of which is, that the difference between the squares of the moon's and earth's distances from the sun is greater in proportion to the squares themselves, in the former than in the latter case at equal elongations from the quadrature; and consequently the disturbing forces must be more considerable.

"Although the moon in reality revolves about the common centre of gravity between her and the earth, and not about the earth itself, and consequently their motions and irregularities are similar, and not confined to the moon alone; yet it may be easily conceived, that the conclusions are not affected in any degree that may be here regarded, when, for the sake of conciseness, we suppose one of the two bodies to be quiescent, and the other to revolve about it.

"Irregularities of the same kind take place among the primary planets, by their mutual actions on each other; but the quantities are not considerable. Hence the apsides of the planets are found to move in consequentia, but so very slowly that some have doubted whether they move at all. The motions of the aphelia of Saturn, Jupiter, Mars, the Earth, Venus, and Mercury, as deduced from the comparison of distant observations, are respectively 2° 30′, 1° 43′ 20″, 1° 51′ 40″, 1° 49′ 10″, 4° 10′, 1° 57′ 40″, in a century.

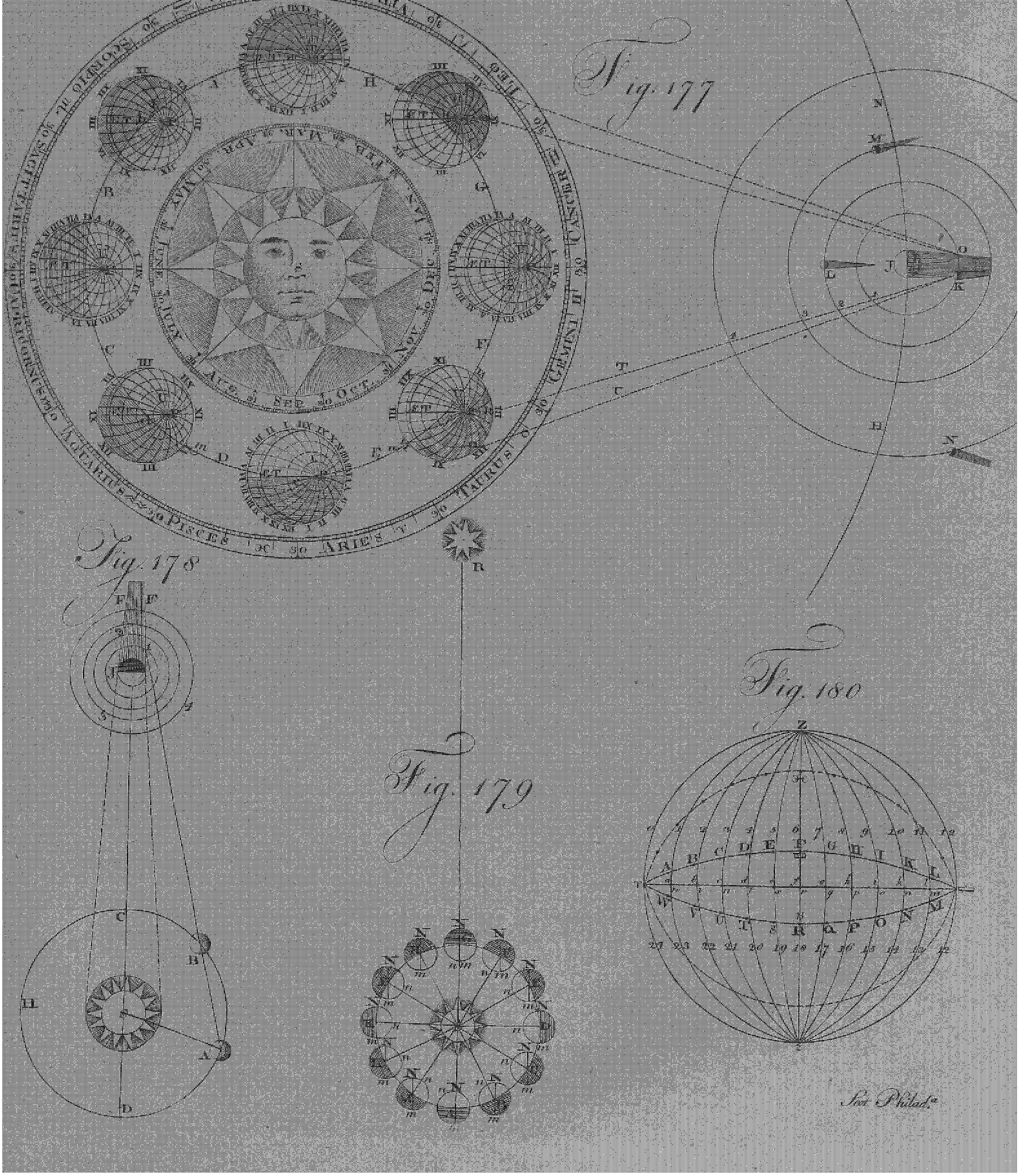
"The actions of the inferior planets on each other are very minute, on account of the smallness of their bulks; but those of Jupiter and Saturn are not altogether insensible. When Jupiter is between the Sun and Saturn, its whole attraction acts upon the latter and increases the gravity of that planet towards the sun. This is found by comparing the respective masses of Jupiter and the Sun; and the respective squares of their distances from Saturn, to be equal to $\frac{1}{211}$ of the Sun's action upon Saturn. That planet, on the other hand, at the conjunction, acts upon Jupiter and the Sun in the same direction; and therefore disturbs their relative position only so far as its actions on each are not equal. The difference of these actions is found, by the same principles, to be $\frac{1}{1523}$ of Jupiter's whole gravity."

Sect. VI. *Of the Ebbing and Flowing of the Sea, and the Phenomena of the Harvest and Horizontal Moon.*

THE cause of the tides was discovered by Kepler, who, in his *Introduction to the Physic of the Heavens*, thus explains it: "The orb of the attracting power, which is in the moon, is extended as far as the earth; and draws the waters under the torrid zone, acting upon places where it is vertical, insensibly on confined seas and bays, but sensibly on the ocean whose beds are large and where the waters have the liberty of reciprocation, that is, of rising and falling." And in the 70th page of his *Lunar Astronomy*—"But the cause of the tides of the sea appears to be the bodies of the sun and moon drawing the waters of the sea." This hint being given, the immortal Sir Isaac Newton improved it,

336 Cause of the tides discovered by Kepler.

ASTRONOMY Plate LXXIX



Ebbing and flowing of the Sea.

and wrote so amply on the subject, as to make the theory of the tides in a manner quite his own, by discovering the cause of their rising on the side of the earth opposite to the moon. For Kepler believed that the presence of the moon occasioned an impulse which caused another in her absence.

It has been already observed, that the power of gravity diminishes as the square of the distance increases; and therefore the waters at Z on the side of the earth ABCDEFGH next the moon M are more attracted than the central parts of the earth O by the moon, and the central parts are more attracted by her than the waters on the opposite side of the earth at *n*: and therefore the distance between the earth's centre and the waters on its surface under and opposite to the moon will be increased. For, let there be three bodies at H, O, and D: if they are all equally attracted by the body M, they will all move equally fast toward it, their mutual distances from each other continuing the same. If the attraction of M is unequal, then that body which is most strongly attracted will move fastest, and this will increase its distance from the other body. Therefore, by the law of gravitation, M will attract H more strongly than it does O, by which the distance between H and O will be increased; and a spectator on O will perceive H rising higher toward Z. In like manner, O being more strongly attracted than D, it will move farther towards M than D does: consequently, the distance between O and D will be increased; and a spectator on O, not perceiving his own motion, will see D receding farther from him towards *n*: all effects and appearances being the same, whether D recedes from O, or O from D.

Fig. 189.

Suppose now there is a number of bodies, as A, B, C, D, E, F, G, H, placed round O, so as to form a flexible or fluid ring: then, as the whole is attracted towards M, the parts at H and D will have their distance from O increased; whilst the parts at B and F being nearly at the same distance from M as O is, these parts will not recede from one another; but rather, by the oblique attraction of M, they will approach nearer to O. Hence, the fluid ring will form itself into an ellipse ZIBL*n*KFNZ, whose longer axis *n* OZ produced will pass through M, and its shorter axis BOF will terminate in B and F. Let the ring be filled with fluid particles, so as to form a sphere round O; then, as the whole moves towards M, the fluid sphere being lengthened at Z and *n*, will assume an oblong or oval form. If M is the moon, O the earth's centre, ABCDEFGH the sea covering the earth's surface, it is evident, by the above reasoning, that whilst the earth by its gravity falls toward the moon, the water directly below her at B will swell and rise gradually towards her, also the water at D will recede from the centre [strictly speaking, the centre recedes from D], and rise on the opposite side of the earth; whilst the water at B and F is depressed, and falls below the former level. Hence as the earth turns round its axis from the moon to the moon again in $24\frac{3}{4}$ hours, there will be two tides of flood and two of ebb in that time, as we find by experience.

364 Why the tides are high at full moon.

As this explanation of the ebbing and flowing of the sea is deduced from the earth's constantly falling towards the moon by the power of gravity, some may find a difficulty in conceiving how this is possible, when the moon is full, or in opposition to the sun; since the earth revolves about the sun, and must continually fall towards it, and therefore cannot fall contrary ways at the same time: or if the earth is constantly falling towards the moon, they must come together at last. To remove this difficulty, let it be considered, that it is not the centre of the earth that describes the annual orbit round the sun, but the (E) common centre of gravity of the earth and moon together: and that whilst the earth is moving round the sun, it also describes a circle round that centre of gravity; going as many times round it in one revolution about the sun as there are lunations or courses of the moon round the earth in a year: and therefore the earth is constantly falling towards the moon from a tangent to the circle it describes round the said common centre of gravity. Let M be the moon, TW part of the moon's orbit, and C the centre of gravity of the earth and moon; whilst the moon goes round her orbit, the centre of the earth describes the circle *d g e* round C, to which circle *g a k* is a tangent; and therefore when the moon has gone from M to a little past W, the earth has moved from *g* to *e*; and in that time has fallen towards the moon, from the tangent at *a* to *e*: and so on, round the whole circle. Fig. 190.

365 Influence of the sun in raising tides.

The sun's influence in raising the tides is but small in comparison of the moon's; for though the earth's diameter bears a considerable proportion to its distance from the moon, it is next to nothing when compared to its distance from the sun. And therefore the difference of the sun's attraction on the sides of the earth under and opposite to him, is much less than the difference of the moon's attraction on the sides of the earth under and opposite to her; and therefore the moon must raise the tides much higher than they can be raised by the sun.

366 Why they are not highest when the moon is in the meridian.

On this theory, the tides ought to be highest directly under and opposite to the moon; that is, when the moon is due north and south. But we find, that in open seas, where the water flows freely, the Moon M is generally past the north and south meridian, as at *p*, when it is high water at Z and at *n*. The reason is obvious: for though the moon's attraction was to cease altogether when she was past the meridian, yet the motion of ascent communicated to the water before that time would make it continue to rise for some time after; much more must it do so when the attraction is only diminished; as a little impulse given to a moving ball will cause it still to move farther than otherwise it could

(E) This centre is as much nearer the earth's centre than the moon's as the earth is heavier, or contains a greater quantity of matter than the moon, namely, about 40 times. If both bodies were suspended on it, they would hang *in æquilibrio*. So that dividing 240,000 miles, the moon's distance from the earth's centre, by 40, the excess of the earth's weight above the moon's the quotient will be 6000 miles, which is the distance of the common centre of gravity of the earth and moon from the earth's centre.

Ebbing and flowing of the Sea.

could have done; and as experience shows, that the day is hotter about three in the afternoon, than when the sun is on the meridian, because of the increase made to the heat already imparted.

The tides answer not always to the same distance of the moon from the meridian at the same places; but are variously affected by the action of the sun, which brings them on sooner when the moon is in her first and third quarters, and keeps them back later when she is in her second and fourth: because, in the former case, the tide raised by the sun alone would be earlier than the tide raised by the moon; and, in the latter case, later.

The moon goes round the earth in an elliptic orbit; and therefore, in every lunar month, she approaches nearer to the earth than her mean distance, and recedes farther from it. When she is nearest, she attracts strongest, and so raises the tides most; the contrary happens when she is farthest, because of her weaker attraction. When both luminaries are in the equator, and the moon in perigee, or at her least distance from the earth, she raises the tides highest of all, especially at her conjunction and opposition; both because the equatorial parts have the greatest centrifugal force from their describing the largest circle, and from the concurring actions of the sun and moon. At the change, the attractive forces of the sun and moon being united, they diminish the gravity of the waters under the moon, and their gravity on the opposite side is diminished by means of a greater centrifugal force. At the full, whilst the moon raises the tide under and opposite to her, the sun, acting in the same line, raises the tide under and opposite to him; whence their conjoint effect is the same as at the change; and, in both cases, occasion what we call the *Spring Tides*. But at the quarters the sun's action on the waters at O and H diminishes the effect of the moon's action on the water at Z and N; so that they rise a little under and opposite to the sun at O and H, and fall as much under and opposite to the moon at Z and N; making what we call the *Neap Tides*, because the sun and moon then act cross-wise to each other. But these tides happen not till some time after; because in this, as in other cases, the actions do not produce the greatest effect when they are at the strongest, but some time afterwards.

The sun, being nearer the earth in winter than in summer, is of course nearer to it in February and October than in March and September; and therefore the greatest tides happen not till some time after the autumnal equinox, and return a little before the vernal.

The sea, being thus put into motion, would continue to ebb and flow for several times, even though the sun and moon were annihilated, or their influence should cease; as, if a bason of water were agitated, the water would continue to move for some time after the bason was left to stand still; or like a pendulum, which, having been put in motion by the hand, continues to make several vibrations without any new impulse.

When the moon is in the equator, the tides are equally high in both parts of the lunar day, or time of the moon's revolving from the meridian to the meridian again, which is 24 hours 50 minutes. But as the moon declines from the equator towards either pole, the tides are alternately higher and lower at places having north or south latitude. For one of the highest elevations, which is that under the moon, follows her towards the pole to which she is nearest, and the other declines towards the opposite pole; each elevation describing parallels as far distant from the equator, on opposite sides, as the moon declines from it to either side; and consequently the parallels described by these elevations of the water are twice as many degrees from one another as the moon is from the equator; increasing their distance as the moon increases her declination, till it be at the greatest, when the said parallels are, at a mean state, 47 degrees from one another: and on that day, the tides are most unequal in their heights. As the moon returns towards the equator, the parallels described by the opposite elevations approach towards each other, until the moon comes to the equator, and then they coincide. As the moon declines towards the opposite pole, at equal distances, each elevation describes the same parallel in the other part of the lunar day, which its opposite elevation described before. Whilst the moon has north declination, the greatest tides in the northern hemisphere are when she is above the horizon; and the reverse whilst her declination is south. Let NESQ be the earth, NSC its axis, EQ the equator, T ♋ the tropic of Cancer, *t* ♑ the tropic of Capricorn, *a b* the arctic circle, *c d* the antarctic, N the north pole, S the south pole, M the moon, F and G the two eminences of water, whose lowest parts are at *a* and *d*, at N and S, and at *b* and *c*, always 90 degrees from the highest. Now, when the moon is in her greatest north declination at M, the highest elevation G under her is on the tropic of Cancer T ♋, and the opposite elevation F on the tropic of Capricorn *t* ♑; and these two elevations describe the tropics by the earth's diurnal rotation. All places in the northern hemisphere ENQ have the highest tides when they come into the position *b* ♋ Q, under the moon: and the lowest tides when the earth's diurnal rotation carries them into the position *a* TE, on the side opposite to the moon; the reverse happens at the same time in the southern hemisphere ESQ, as is evident to sight. The axis of the tides *a* C *d* has now its poles *a* and *d* (being always 90 degrees from the highest elevations) in the arctic and antarctic circles; and therefore it is plain, that at these circles there is but one tide of flood, and one of ebb, in the lunar day. For, when the point *a* revolves half round to *b*, in 12 lunar hours, it has a tide of flood; but when it comes to the same point *a* again in 12 hours more, it has the lowest ebb. In seven days afterward, the moon M comes to the equinoctial circle, and is over the equator EQ, when both elevations describe the equator; and in both hemispheres, at equal distances from the equator, the tides are equally high in both parts of the lunar day. The whole phenomena being reversed, when the moon has south declination, to what they were when her declination was north, require no farther description. Fig. 192, 193, 194.

In the three last-mentioned figures, the earth is orthographically projected on the plane of the meridian; but in order to describe a particular phenomenon, we now project it on the plane of the ecliptic. Let HZON be the earth and sea, FED the equator, T the tropic of Cancer, C the arctic circle, P the north pole, and the curves, 1, 2, 3, &c. 24 meridians or Fig. 191.

Ebbing and flowing of the Sea.

hour-circles, intersecting each other in the poles; AGM is the moon's orbit, S the sun, M the moon, Z the water elevated under the moon, and N the opposite equal elevation. As the lowest parts of the water are always 90 degrees from the highest, when the moon is in either of the tropics (as at M), the elevation Z is on the tropic of Capricorn, and the opposite elevation N on the tropic of Cancer; the low-water circle HCO touches the polar circles at C; and the high-water circle ETP6 goes over the poles at P, and divides every parallel of latitude into two equal segments. In this case, the tides upon every parallel are alternately higher and lower; but they return in equal times: the point T, for example, on the tropic of Cancer (where the depth of the tide is represented by the breadth of the dark shade), has a shallower tide of flood at T than when it revolves half round from thence to 6, according to the order of the numeral figures; but it revolves as soon from 6 to T as it did from T to 6. When the moon is in the equinoctial, the elevations Z and N are transferred to the equator at O and H, and the high and low-water circles are got into each other's former places; in which case the tides return in unequal times, but are equally high in both parts of the lunar day: for a place at I (under D) revolving as formerly, goes sooner from I to II (under F) than from II to I, because the parallel it describes is cut into unequal segments by the high water circle HCO: but the points I and II being equidistant from the pole of the tides at C, which is directly under the pole of the moon's orbit MGA, the elevations are equally high in both parts of the day.

367 Tides turn on the axis of the moon's orbit.

And thus it appears, that as the tides are governed by the moon, they must turn on the axis of the moon's orbit, which is inclined $23\frac{1}{2}$ degrees to the earth's axis at a mean state: and therefore the poles of the tides must be so many degrees from the poles of the earth, or in opposite points of the polar circles, going round these circles in every lunar day. It is true, that according to fig. 194. when the moon is vertical to the equator ECQ, the poles of the tides seem to fall in with the poles of the world N and S: but when we consider that FGH is under the moon's orbit, it will appear, that when the moon is over H, in the tropic of Capricorn, the north pole of the tides (which can be no more than 90 degrees from under the moon) must be at C in the arctic circle, not at P the north pole of the earth; and as the moon ascends from H to G in her orbit, the north pole of the tides must shift from *c* to *a* in the arctic circle, and the south poles as much in the antarctic.

It is not to be doubted, but that the earth's quick rotation brings the poles of the tides nearer to the poles of the world, than they would be if the earth were at rest and the moon revolved about it only once a month; for otherwise the tides would be more unequal in their heights and times of their return, than we find they are. But how near the earth's rotation may bring the poles of its axis and those of the tides together, or how far the preceding tides may affect those which follow, so as to make them keep up nearly to the same heights and times of ebbing and flowing, is a problem more fit to be solved by observation than by theory.

Those who have opportunity to make observations, and choose to satisfy themselves whether the tides are really affected in the above manner by the different positions of the moon, especially as to the unequal times of their returns, may take this general rule for knowing when they ought to be so affected. When the earth's axis inclines to the moon, the northern tides, if not retarded in their passage through shoals and channels, nor affected by the winds, ought to be greatest when the moon is above the horizon, least when she is below it; and quite the reverse when the earth's axis declines from her: but in both cases, at equal intervals of time. When the earth's axis inclines sidewise to the moon, both tides are equally high, but they happen at unequal intervals of time. In every lunation the earth's axis inclines once to the moon, once from her, and twice sidewise to her, as it does to the sun every year; because the moon goes round the ecliptic every month, and the sun but once in a year. In summer, the earth's axis inclines towards the moon when new; and therefore the day-tides in the north ought to be highest, and night-tides lowest, about the change: at the full, the reverse. At the quarters, they ought to be equally high, but unequal in their returns; because the earth's axis then inclines sidewise to the moon. In winter, the phenomena are the same at full moon as in summer at new. In autumn, the earth's axis inclines sidewise to the moon when new and full; therefore, the tides ought to be equally high and uneven in their returns at these times. At the first quarter, the tides of flood should be least when the moon is above the horizon, greatest when she is below it: and the reverse at her third quarter. In spring, the phenomena of the first quarter answer to those of the third quarter in autumn; and *vice versa*. The nearer any time is to either of these seasons, the more the tides partake of the phenomena of these seasons; and in the middle between any two of them the tides are at a mean state between those of both.

In open seas, the tides rise but to very small heights in proportion to what they do in wide-mouthed rivers, opening in the direction of the stream of tide. For in channels growing narrower gradually, the water is accumulated by the opposition of the contracting bank: like a gentle wind, little felt on an open plane, but strong and brisk in a street; especially if the wider end of the street be next the plain, and in the way of the wind.

268 Irregularities of tides accounted for.

The tides are so retarded in their passage thro' different shoals and channels, and otherwise so variously affected by striking against capes and headlands, that to different places they happen at all distances of the moon from the meridian, consequently at all hours of the lunar day. The tide propagated by the moon in the German ocean, when she is three hours past the meridian, takes 12 hours to come from thence to London bridge; where it arrives by the time that a new tide is raised in the ocean. And therefore, when the moon has north declination, and we should expect the tide at London to be greatest when the moon is above the horizon, we find it is least; and the contrary when she has south declination. At several places it is high-water three hours before the moon comes to the meridian; but that tide which the moon pushes as it were before her, is only the tide opposite to that which was raised by her when she was nine hours past the opposite meridian.

There are no tides in lakes, because they are generally

Ebbing and flowing of the Sea.

rally so small, that when the moon is vertical she attracts every part of them alike, and therefore by rendering all the water equally light, no part of it can be raised higher than another. The Mediterranean and Baltic seas have very small elevations, because the inlets by which they communicate with the ocean are so narrow, that they cannot, in so short a time, receive or discharge enough to raise and sink their surfaces sensibly.

369
Why the moon does not affect the barometer.

Air being lighter than water, and the surface of the atmosphere being nearer to the moon than the surface of the sea, it cannot be doubted that the moon raises much higher tides in the air than in the sea. And therefore many have wondered why the mercury does not sink in the barometer when the moon's action on the particles of air makes them lighter as she passes over the meridian. But we must consider, that as these particles are rendered lighter, a greater number of them are accumulated, until the deficiency of gravity be made up by the height of the column; and then there is an equilibrium, and consequently an equal pressure upon the mercury as before; so that it cannot be affected by the aerial tides. It is very probable, however, that the stars which are seen through an aerial tide of this kind will have their light more refracted than those which are seen through the common depth of the atmosphere; and this may account for the supposed refractions by the lunar atmosphere that have been sometimes observed.

370
Of the harvest moon.

It is generally believed that the moon rises about 50 minutes later every day than on the preceding; but this is true only with regard to places on the equator. In places of considerable latitude there is a remarkable difference, especially in the harvest time. Here the autumnal full moon rises very soon after sun-set for several evenings together. At the polar circles, where the mild season is of very short duration, the autumnal full moon rises at sun-set from the first to the third quarter. And at the poles, where the sun is for half a year absent, the winter full-moons shine constantly without setting from the first to the third quarter.

All these phenomena are owing to the different angles made by the horizon and different parts of the moon's orbit; and may be explained in the following manner.

The plane of the equinoctial is perpendicular to the earth's axis; and, therefore as the earth turns round its axis, all parts of the equinoctial make equal angles with the horizon both at rising and setting: so that equal portions of it always rise or set in equal times. Consequently, if the moon's motions were equable, and in the equinoctial, at the rate of 12 degrees 11 min. from the sun every day, as it is in her orbit, she would rise and set 50 minutes later every day than on the preceding: for 12 deg. 11 min. of the equinoctial rise or set in 50 minutes of time in all latitudes.

But the moon's motion is so nearly in the ecliptic, that we may consider her at present as moving in it. Now the different parts of the ecliptic, on account of its obliquity to the earth's axis, make very different angles with the horizon as they rise or set. Those parts or signs which rise with the smallest angles set with the greatest, and *vice versa*. In equal times, whenever this angle is least, a greater portion of the ecliptic rises than when the angle is larger; as may be seen by elevating the pole of a globe to any considerable latitude, and then turning it round its axis in the horizon. Consequently, when the moon is in those signs which rise or set with the smallest angles, she rises or sets with the least difference of time; and with the greatest difference in those signs which rise or set with the greatest angles.

Let FUP be the axis of a globe, ♋ TR the tropic of Cancer, L*t* ♑ the tropic of Capricorn, ♋ EU ♑ the ecliptic touching both the tropics, which are 47 degrees from each other, and AB the horizon. The equator, being in the middle between the tropics, is cut by the ecliptic into two opposite points, which are the beginnings of Aries and Libra, K is the hour-circle with its index, F the north pole of the globe elevated to a considerable latitude, suppose 40 degrees above the horizon; and P the south pole depressed as much below it. Because of the oblique position of the sphere in this latitude, the ecliptic has the high elevation N ♋ above the horizon, making the angle NU ♋ of $73\frac{1}{2}$ degrees with it when Cancer is on the meridian, at which time Libra rises in the east. But let the globe be turned half round it axis, till Capricorn comes to the meridian and Aries rises in the east; and then the ecliptic will have the low elevation NL above the horizon, making only an angle NUL of $26\frac{1}{2}$ degrees with it; which is 47 degrees less than the former angle, equal to the distance between the tropics. Fig. 187.

In Northern latitudes, the smallest angle made by the ecliptic and horiz is when Aries rises, at which time Libra sets; the greatest when Libra rises, at which time Aries sets. From the rising of Aries to the rising of Libra (which is twelve (A) sidereal hours) the angle increases; and from the rising of Libra to the rising of Aries, it decreases in the same proportion. By this article and the preceding, it appears, that the ecliptic rises fastest about Aries, and slowest about Libra.

On the parallel of London, as much of the ecliptic rises about Pisces and Aries in two hours as the moon goes through in six days: and therefore, whilst the moon is in these signs, she differs but two hours in rising for six days together; that is, about 20 minutes later every day or night than on the preceding, at a mean rate, But in 14 days afterwards the moon comes to Virgo and Libra, which are the opposite signs to Pisces and Aries; and then she differs almost four times as much in rising; namely, one hour and about fifteen minutes later every day or night than the former, whilst she is in these signs.

As the moon can never be full but when she is opposite to the sun, and the sun is never in Virgo and Libra but in our autumnal months, it is plain that the moon

(A) The ecliptic, together with the fixed stars, make $366\frac{1}{4}$ apparent diurnal revolutions about the earth in a year; the sun only $365\frac{1}{4}$. Therefore the stars gain 3 minutes 56 seconds upon the sun every day: so that a sidereal day contains only 23 hours 56 minutes of mean solar time, and a natural or solar day 24 hours. Hence 12 sidereal hours are 11 minutes 58 seconds shorter than 12 solar.

Fig. 181

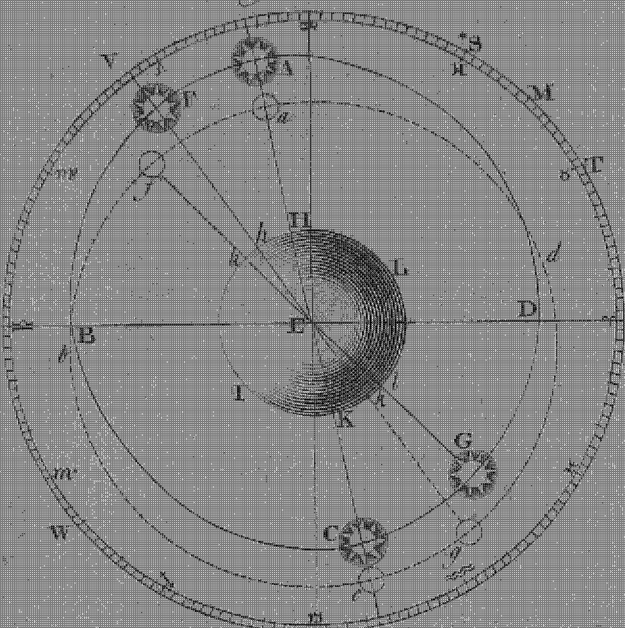


Fig. 182

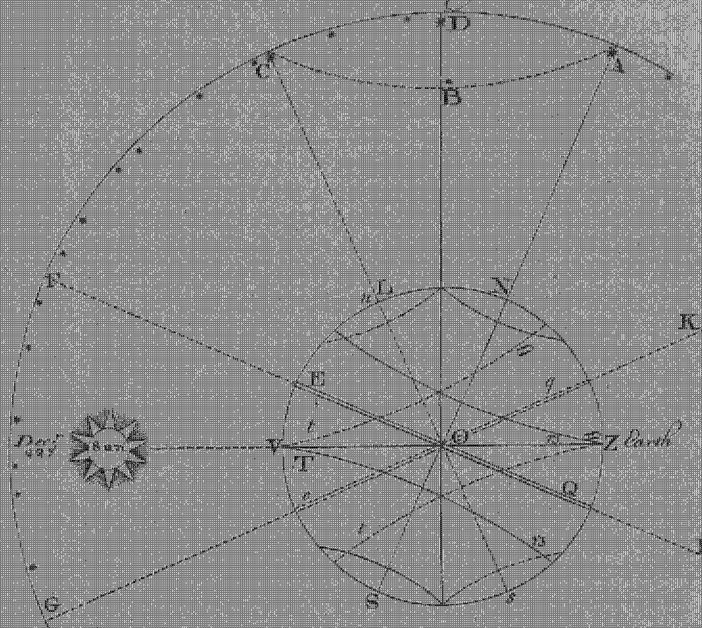


Fig. 183

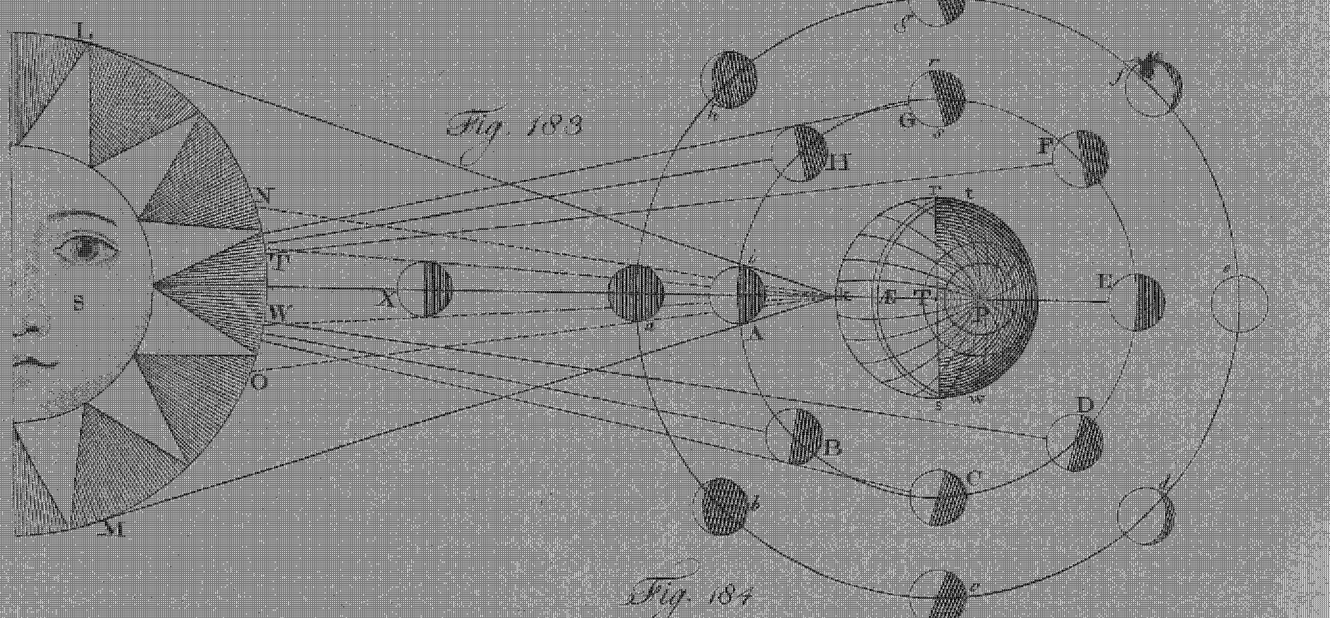


Fig. 184

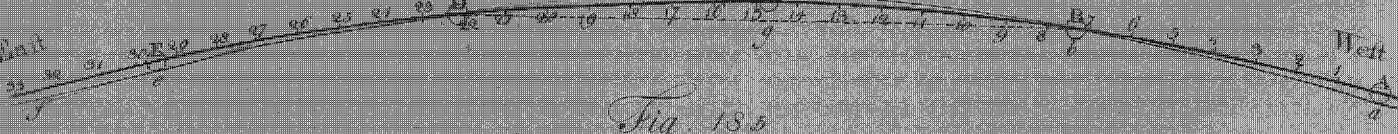
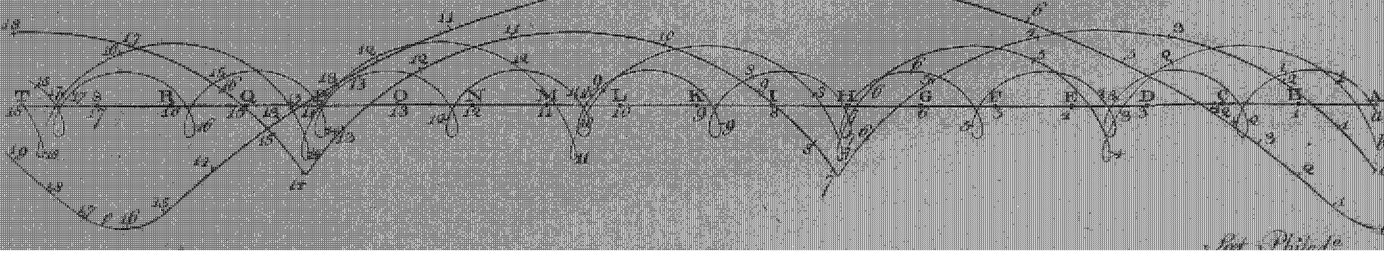


Fig. 185



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Harvest and Horizontal Moon.

moon is never full in the opposite signs, Pisces and Aries, but in those two months. And therefore we can have only two full moons in the year, which rise so near the time of sun-set for a week together as abovementioned. The former of these is called the *harvest moon*, and the latter the *hunter's moon*.

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Why the same phenomenon is not observed at other times.

Here it will probably be asked, why we never observe this remarkable rising of the moon but in harvest, seeing she is in Pisces and Aries twelve times in the year besides; and must then rise with as little difference of time as in harvest? The answer is plain; for in winter these signs rise at noon; and being then only a quarter of a circle distant from the sun, the moon in them is in her first quarter: but when the sun is above the horizon, the moon's rising is neither regarded nor perceived. In spring, these signs rise with the sun, because he is then in them; and as the moon changeth in them at that time of the year, she is quite invisible. In summer they rise about midnight; and the sun being then three signs, or a quarter of a circle, before them, the moon is in them about her third quarter; when rising so late, and giving but very little light, her rising passes unobserved. And in autumn, these signs, being opposite to the sun, rise when he sets, with the moon in opposition, or at the full, which makes her rising very conspicuous.

At the equator, the north and south poles lie in the horizon; and therefore the ecliptic makes the same angle southward with the horizon when Aries rises, as it does northward when Libra rises. Consequently, as the moon rises and sets nearly at equal angles with the horizon all the year round, and about 50 minutes later every day or night than on the preceding, there can be no particular harvest-moon at the equator.

The farther that any place is from the equator, if it be not beyond the polar circle, the more the angle is diminished which the ecliptic and horizon make when Pisces and Aries rise: and therefore when the moon is in these signs, she rises with a nearly proportionable difference later every day than on the former; and is for that reason the more remarkable about the full, until we come to the polar circles, or 66 degrees from the equator; in which latitude the ecliptic and horizon become coincident every day for a moment, at the same sidereal hour (or 3 minutes 56 seconds sooner every day than the former), and the very next moment one half of the ecliptic, containing Capricorn, Aquarius, Pisces, Aries, Taurus, and Gemini, rises, and the opposite half sets. Therefore, whilst the moon is going from the beginning of Capricorn to the beginning of Cancer, which is almost 14 days, she rises at the same sidereal hour; and in autumn just at sun-set, because all that half of the ecliptic, in which the sun is at that time, sets at the same sidereal hour, and the opposite half rises; that is, 3 minutes 56 seconds of mean solar time, sooner every day than on the day before. So whilst the moon is going from Capricorn to Cancer, she rises earlier every day than on the preceding; contrary to what she does at all places between the polar circles. But during the above 14 days, the moon is 24 sidereal hours later in setting: for the six signs which rise all at once on the eastern side of the horizon are 24 hours in setting on the western side of it.

In northern latitudes the autumnal full moons are in Pisces and Aries, and the vernal full moons in Virgo and Libra; in southern latitudes, just the reverse, because the seasons are contrary. But Virgo and Libra rise at as small angles with the horizon in southern latitudes, as Pisces and Aries do in the northern; and therefore the harvest-moons are just as regular on one side of the equator as on the other.

Harvest and Horizontal Moon.

As these signs, which rise with the least angles, set with the greatest, the vernal full moons differ as much in their times of rising every night as the autumnal full moons differ in their times of setting; and set with as little difference as the autumnal full moons rise; the one being in all cases the reverse of the other.

Hitherto, for the sake of plainness, we have supposed the moon to move in the ecliptic, from which the sun never deviates. But the orbit in which the moon really moves is different from the ecliptic; one half being elevated $5\frac{1}{3}$ degrees above it, and the other half as much depressed below it. The moon's orbit therefore intersects the ecliptic in two points diametrically opposite to each other; and these intersections are called the *Moon's Nodes*. So the moon can never be in the ecliptic but when she is in either of her nodes, which is at least twice every course from change to change, and sometimes thrice: For, as the moon goes almost a whole sign more than around her orbit from change to change; if she passes by either node about the time of change, she will pass by the other in about 14 days after, and come round to the former node two days again before the next change. That node from which the moon begins to ascend northward, or above the ecliptic, in northern latitudes, is called the *Ascending Node;* and the other the *Descending Node*, because the moon, when she passes by it, descends below the ecliptic southward.

The moon's oblique motion with regard to the ecliptic causes some difference in the times of her rising and setting from what is already mentioned. For when she is northward of the ecliptic, she rises sooner and sets later than if she moved in the ecliptic: and when she is southward of the ecliptic, she rises later and sets sooner. This difference is variable, even in the same signs, because the nodes shift backward about $19\frac{2}{3}$ degrees in the ecliptic every year; and so go round it contrary to the order of the signs in 18 years 225 days.

When the ascending node is in Aries, the southern half of the moon's orbit makes an angle of $5\frac{1}{3}$ degrees less with the horizon than the ecliptic does, when Aries rises in northern latitudes: for which reason the moon rises with less difference of time whilst she is in Pisces and Aries, than she would do if she kept in the ecliptic. But in 9 years and 112 days afterward, the descending node comes to Aries; and then the moon's orbit makes an angle $5\frac{1}{3}$ degrees greater with the horizon when Aries rises, than the ecliptic does at that time; which causes the moon to rise with greater difference of time in Pisces and Aries than if she moved in the ecliptic.

To be a little more particular: When the ascending node is in Aries, the angle is only $9\frac{2}{3}$ degrees on the parallel of London when Aries rises; but when the descending node comes to Aries, the angle is $20\frac{1}{3}$ degrees. This occasions as great a difference of the

moon's

Harvest and Horizontal Moon.

moon's rising in the same signs every nine years, as there would be on two parallels $10\frac{1}{2}$ degrees from one another, if the moon's course were in the ecliptic.

372 Revolution of the moon's nodes.

As there is a complete revolution of the nodes in $18\frac{2}{3}$ years, there must be a regular period of all the varieties which can happen in the rising and setting of the moon during that time. But this shifting of the nodes never affects the moon's rising so much, even in her quickest descending latitude, as not to allow us still the benefit of her rising nearer the time of sun-set for a few days together about the full in harvest, than when she is full at any other time of the year.

373 Long moon-light in winter at the poles.

At the polar circles, when the sun touches the summer tropic, he continues 24 hours above the horizon; and 24 hours below it, when he touches the winter tropic. For the same reason, the full moon neither rises in summer nor sets in winter, considering her as moving in the ecliptic. For the winter full moon being as high in the ecliptic as the summer sun, must therefore continue as long above the horizon; and the summer full moon being as low in the ecliptic as the winter sun, can no more rise than he does. But these are only the two full moons which happen about the tropics, for all the others rise and set. In summer, the full moons are low, and their stay is short above the horizon, when the nights are short, and we have least occasion for moon light: in winter they go high, and stay long above the horizon, when the nights are long, and we want the greatest quantity of moon-light.

At the poles, one half of the ecliptic never sets, and the other half never rises: and therefore, as the sun is always half a year in describing one half of the ecliptic, and as long in going through the other half, it is natural to imagine that the sun continues half a year together above the horizon of each pole in its turn, and as long below it; rising to one pole when he sets to the other. This would be exactly the case if there were no refraction: but by the atmosphere's refracting the sun's rays, he becomes visible some days sooner, and continues some days longer in sight, than he would otherwise do: so that he appears above the horizon of either pole before he has got below the horizon of the other. And, as he never goes more than $23\frac{1}{2}$ degrees below the horizon of the poles, they have very little dark night; it being twilight there, as well as at other places, till the sun be 18 degrees below the horizon. The full moon, being always opposite to the sun, can never be seen while the sun is above the horizon, except when she is in the northern half of her orbit; for whenever any point of the ecliptic rises, the opposite point sets. Therefore, as the sun is above the horizon of the north pole from the 20th of March till 23d of September, it is plain that the moon, when full, being opposite to the sun, must be below the horizon during that half of the year. But when the sun is in the southern half of the ecliptic, he never rises to the north pole; during which half of the year, every full moon happens in some part of the northern half of the ecliptic which never sets. Consequently, as the polar inhabitants never see the full moon in summer, they have her always in the winter, before, at, and after, the full, shining for 14 of our days and nights. And when the sun is at his greatest depression below the horizon, being then in Capricorn, the moon is at her third quarter in Aries, full in Cancer, and at her first quarter in Libra. And as the beginning of Aries is the rising point of the ecliptic, Cancer the highest, and Libra the setting point, the moon rises at her first quarter in Aries; is most elevated above the horizon, and full, in Cancer; and sets at the beginning of Libra, in her third quarter, having continued visible for 14 diurnal rotations of the earth. Thus the poles are supplied one-half of the winter-time with constant moon-light in the sun's absence; and only lose sight of the moon from her third to her first quarter, while she gives but very little light and could be but of little and sometimes of no service to them. A bare view of the figure will make this plain: in which let S be the sun; e, the earth in summer, when its north pole *n* inclines towards the sun; and E the earth in winter, when its north pole declines from him. SEN and NWS is the horizon of the north pole, which is coincident with the equator; and, in both these positions of the earth, ♈ ♋ ♎ ♑ is the moon's orbit, in which she goes round the earth, according to the order of the letters *a b c d*, A B C D. When the moon is at *a* she is in her third quarter to the earth at e, and just rising to the north pole *n*; at *b* she changes, and is at the greatest height above the horizon, as the sun likewise is; at *c* she is in her first quarter, setting below the horizon; and is lowest of all under it at *d*, when opposite to the sun, and her enlightened side toward the earth. But then she is full in view to the south pole *p*: which is as much turned from the sun as the north pole inclines toward him. Thus, in our summer, the moon is above the horizon of the north pole whilst she describes the northern half of the ecliptic ♈ ♋ ♎, or from her third quarter to her first; and below the horizon during her progress through the southern half ♎ ♑ ♈; highest at the change, most depressed at the full. But in winter, when the earth is at E, and its north pole declines from the sun, the new moon at D is at her greatest depression below the horizon NWS, and the full moon at B at her greatest height above it; rising at her first quarter A, and keeping above the horizon till she comes to her third quarter C. At a mean state she is $23\frac{1}{2}$ degrees above the horizon at B and *b*, and as much below it at D and *d*, equal to the inclination of the earth's axis F. S ♋, or S ♑, are, as it were, a ray of light proceeding from the sun to the earth; and shows that when the earth is at e, the sun is above the horizon, vertical to the tropic of Cancer; and when the earth is at E, he is below the horizon, vertical to the tropic of Capricorn. Fig. 188.

374 Horizontal moon accounted for by Mr Ferguson.

The sun and moon generally appear larger when near the horizon than when at a distance from it; for which there have been various reasons assigned. The following account is given by Mr Ferguson: "These luminaries although at great distances from the earth, appear floating as it were on the surface of our atmosphere, HGF*fc*C, a little way beyond the clouds; of which, those about F, directly over our heads at E, are nearer us than those about H or c in the horizon HEc. Therefore, when the sun or moon appear in the horizon at *e*, they are not only seen in a part of the sky which is really farther from us than if they were at any considerable altitude, as about *f*; but they are also seen through a greater quantity of air and vapours at c than at *f*. Here we have two concurring appear- Fig. 170.

ances

Harvest and Horizontal Moon.

ances which deceive our imagination, and cause us to refer the sun and moon to a greater distance at their rising or setting about c, than when they are considerably high, as at *f*: first, their seeming to be on a part of the atmosphere at c, which is really farther than *f* from a spectator at E; and, secondly, their being seen through a grosser medium when at c than when at *f*, which, by rendering them dimmer, causes us to imagine them to be at a yet greater distance. And as, in both cases, they are seen much under the same angle, we naturally judge them to be largest when they seem farthest from us.

"Any one may satisfy himself that the moon appears under no greater angle in the horizon than on the meridian, by taking a large sheet of paper, and rolling it up in the form of a tube, of such a width, that, observing the moon through it when she rises, she may as it were just fill the tube; then tie a thread round it to keep it of that size; and when the moon comes to the meridian, and appears much less to the eye, look at her again through the same tube, and she will fill it just as much, if not more, than she did at her rising.

"When the full moon is in her perigee, or at her least distance from the earth, she is seen under a larger angle, and must therefore appear bigger than when she is full at other times: And if that part of the atmosphere where she rises be more replete with vapours than usual, she appears so much the dimmer; and therefore we fancy her to be still the bigger, by referring her to an unusually great distance, knowing that no objects which are very far distant can appear big unless they really be so."

375 By Mr Dunn.

To others this solution has appeared unsatisfactory; and accordingly Mr Dunn has given the following dissertation on this phenomenon, Phil. Transf. Vol. LXIV.

"1. The sun and moon, when they are in or near the horizon, appear to the naked eye of the generality of persons, so very large in comparison with their apparent magnitudes when they are in the zenith, or somewhat elevated, that several learned men have been led to inquire into the cause of this phenomenon; and after endeavouring to find certain reasons, founded on the principles of physics, they have at last pronounced this phenomenon a mere optical illusion.

"2. The principal dissertations which I have seen conducing to give any information on this subject, or helping to throw any light on the same, have been those printed in the Transactions of the Royal Society, the Academy of Sciences at Paris, the German Acts, and Dr Smith's Optics; but as all the accounts which I have met with in these writings any way relative to this subject, have not given me that satisfaction which I have desired, curiosity has induced me to inquire after the cause of this singular phenomenon in a manner somewhat different from that which others have done before me, and by such experiments and observations as have appeared to me pertinent; some of which have been as follows, viz.

"3. I have observed the rising and setting sun near the visible horizon, and near rising grounds elevated above the visible horizon about half a degree, and found him to appear largest when near to the visible horizon; and particularly a considerable alteration of his magnitude and light has always appeared to me from the time of his being in the horizon at rising, to the time of his being a degree or two above the horizon, and the contrary at his setting; which property I have endeavoured to receive as a prejudice, and an imposition on my sight and judgment, the usual reasons for this appearance.

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"4. I have also observed that the sun near the horizon appears to put on the figure of a spheroid, having its vertical diameter appearing to the naked eye shorter than the horizontal diameter; and, by measuring those diameters in a telescope, have found the vertical one shorter than the other.

"5. I have made frequent observations and comparisons of the apparent magnitude of the sun's disk, with objects directly under him, when he has been near the horizon, and with such objects as I have found by measurement to be of equal breadth with the sun's diameter; but in the sudden transition of the eye from the sun to the object, and from the object to the sun, have always found the sun to appear least; and that when two right lines have been imaginarily produced by the sides of those equal magnitudes, they have not appeared to keep parallel, but to meet beyond the sun.

"6. From these and other like circumstances, I first began to suspect that a sudden dip of the sun into the horizontal vapours, might some how or other be the cause of a sudden apparent change of magnitude; although the horizontal vapours had been disallowed to be able to produce any other than a refraction in a vertical direction; and, reducing things to calculation, found, that from the time when the sun is within a diameter or two of the horizon, to the time when he is a semidiameter below the horizon, the sun's rays become passable through such a length of medium, reckoning in the direction of the rays, that the total quantity of medium (reckoning both depth and density) through which the rays pass, being compared with the like total depth and density through which they pass at several elevations, it was proportionable to the difference of apparent magnitude, as appearing to the naked eye.

"7. This circumstance of sudden increase and decrease of apparent magnitude, and as sudden decrease and increase of light (for they both go together), seemed to me no improbable cause of the phenomenon, although I could not then perceive how such vapours might contribute towards enlarging the diameter of the sun in a horizontal direction.

"8. I therefore examined the sun's disk again and again, by the naked eye and by telescopes, at different altitudes; and, among several circumstances, found the solar maculæ to appear larger and plainer to the naked eye, and through a telescope, the sun being near the horizon, than they had appeared the same days when the sun was on the meridian, and to appearance more strongly defined, yet obscured.

"9. A little before sun-setting, I have often seen the edge of the sun with such protuberances and indentures as have rendered him in appearance a very odd figure; the protuberances shooting out far beyond, and the indentures pressing into the disk of the sun; and always, through a telescope magnifying 55 times, the the lower limb has appeared with a red glowing arch beneath it, and close to the edge of the sun, while the other parts have been clear.

"10. At

Harvest and Horizontal Moon.

" 10. At sun-setting, these protuberances and indentures have appeared to slide along the vertical limbs, from the lower limb to the higher, and their vanishing, so as often to form a segment of the sun's upper limb apparently separated from the disk for a small space of time.

" 11. At sun-rising I have seen the like protuberances, indentures and slices, above described; but with this difference of motion, that at sun-rising they first appear to rise in the sun's upper limb, and slide or move downward to the lower limb; or which is the same thing, they always appear at the rising and setting of the sun, to keep in the same parallels of altitude by the telescope. This property has been many times so discernable, even by the naked eye, that I have observed the sun's upper limb to shoot out towards right and left, and move downwards, forming the upper part of the disk an apparent portion of a lesser spheroid than the lower part at rising, and the contrary at setting. Through the telescope this has appeared more plain in proportion to the power of magnifying.

" 11. These protuberances and indentures so easily measurable by the micrometer, whilst the telescope wires appeared strait, enabled me to conclude, that certain strata of the atmosphere have different refractive powers; and, lying horizontally across the conical or cycloidal space traced out by the rays between the eye and that part of the atmosphere first touched by the rays, must have been the cause of such apparent protuberances and indentures in an horizontal direction across the sun's vertical limbs; and also that the bottoms of those protuberances and indentures must be considerably enlarged, and removed to appearance farther from the centre of the disk than they would have been had there been no such strata to refract.

" 13. Before sun-rising, when the sun has been near the tropic; and the sky, at the utmost extent of the horizon which appeared very clear; and when certain fogs have appeared in strata placed alternately between the hills, and over intervening rivers, valleys, &c. so as to admit a sight of the rising sun over those fogs; I have observed with admiration the most distant trees and bushments, which at other times have appeared small to the naked eye, but while the sun has been passing along a little beneath the horizon obliquely under them, just before sun-rising, when the sun has been thus approaching towards trees and bushments, they have grown apparently very large to the naked eye, and also through a telescope; and they have lost that apparent largeness as the sun has been passed by them. Thus a few trees standing together on the rising ground, at the distance of a few miles, have appeared to grow up into an apparent mountain. Such apparent mountains formed from trees put on all forms and shapes, as sloping, perpendicular, over-leaning, &c. but soon recover their natural appearance when the sun is past by them, or got above the horizon.

" 14. Mountains themselves, at a distance, sometimes appear larger than at other times. Beasts and cattle in the midst of, and being surrounded with, water, appear nearer to us than when no water surrounds them. Cattle, houses, trees, all objects on the summit of a hill, when seen through a fog, and at a proper distance, appear enlarged. All bodies admit of larger apparent magnitudes when seen through some mediums than others.

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" But more particularly,

" 15. I took a cylindrical glass-vessel about two feet high; and having graduated its sides to inches, I placed it upright on a table, with a piece of paper under the bottom of the glass, on which paper were drawn parallel right lines at proper distances from each other; and having placed a shilling at the bottom of the vessel, it was nearly as low as the paper. Pouring water into the vessel, and viewing the shilling through the medium of water with one eye, whilst I beheld with the other eye where the edges of the shilling were projected on the paper and its parallels, I found the shilling appear larger at every additional inch depth of the water; and this was the case if either eye was used; and the same when the eye was removed far from the surface or near to it, or in any proportion thereto.

" 16. I took large vessels; and, filling them with water, placed different bodies at the bottoms of those vessels. It always followed, that the greater depth of water I looked through, in a direction from my eye to the objects in the water, the nearer those objects appeared to me. Thus light bodies appeared more mellow and faint, and dark bodies rather better defined, than out of the water, when they were not deeply immersed. And thus they appeared under whatever directions or positions I viewed the bodies.

" 17. I placed different bodies in proper vessels of fair water, and immersed my face in the water; viewing the bodies in and through the water. They all appeared to me plain, when not too far from the eye; and altho' a little hazy at the edges, they appeared much enlarged, and always larger through a greater depth of water. Thus a shilling appeared nearly as large as half a crown, with a red glowing arch on that side opposite to the sun, when the sun shined on the water. From this experiment I concluded, that divers see light objects not only larger, but very distinctly, in the water."

From these experiments he draws a confirmation of his doctrine, that the appearances treated of arise from the different strata of the atmosphere; and then concludes that the rays coming from the sun are by the horizontal vapours " first obstructed, and many of them totally absorbed; the rest proceeding with a retarded motion, are thereby first reflected, and then less refracted through the humours of the eye; and, lastly, that hereby the image on the retina becomes enlarged."

Sect. VII. *Of drawing a Meridian Line. Of Solar and Sidereal Time, and of the Equation of Time.*

The foundation of all astronomical observations is a knowledge of the exact time when the sun, or any other of the celestial bodies, comes to the meridian; and therefore astronomers have been very attentive to the most proper methods of drawing a meridian line, by which only this can be exactly known. The easiest method of doing this is the following, recommended by Mr Ferguson, and is found a very good method of placing a sun-dial horizontally on its pedestal.

Make four or five concentric circles (fig. 5.) about a quarter of an inch from one another, on a flat board about a foot in breadth; and let the utmost circle be but little 376 Ferguson's method of drawing a meridian line.

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little less than the board will contain. Fix a pin perpendicularly in the centre, and of such a length that its whole shadow may fall within the innermost circle for at least four hours in the middle of the day. The pin ought to be about an eighth part of an inch thick, and to have a round blunt point. The board being set exactly level in the place where the sun shines, suppose from eight in the morning till four in the afternoon, about which hours the end of the shadow should fall without all the circles; watch the times in the forenoon when the extremity of the shortening shadow just touches the several circles, and there make marks. Then, in the afternoon of the same day, watch the lengthening shadow; and where its end touches the several circles in going over them, make marks also. Lastly, with a pair of compasses, find exactly the middle point between the two marks on any circle, and draw a straight line from the centre to that point; which line will be covered at noon by the shadow of a small upright wire, which should be put in the place of the pin. The reason for drawing several circles is that in case one part of the day should prove clear, and the other part somewhat cloudy, if you miss the time when the point of the shadow should touch one circle, you may perhaps catch it in touching another. The pin is usually about five inches in length. The best time for drawing a meridian line in this manner is about the summer solstice; because the sun changes his declination slowest, and his altitude fastest, in the longest days.

If the casement of a window on which the sun shines at noon be quite upright, you may draw a line along the edge of its shadow on the floor, when the shadow of the pin is exactly on the meridian line of the board: and as the motion of the shadow of the casement will be much more sensible on the floor than that of the shadow of the pin on the board, you may know to a few seconds when it touches the meridian line on the floor.

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Another from the Phil. Transf.

This method may suffice for ordinary purposes, but for astronomers the following is preferable. Take the gnomon of an horizontal dial for the latitude of the place, and to the hypotenusa fix two sights, whose centres may be parallel to the same: let the eye-sight be a small hole, but the other's diameter must be equal to the tangent of the double distance of the north-star from the pole; the distance of the sights being made radius, let the stile be rivetted to the end of a straight ruler; then when you would make use of it, lay the ruler on an horizontal plane, so that the end to which the stile is fixed may overhang; then look through the eye-sight, moving the instrument till the north-star appears to touch the circumference of the hole in the other sight, on the same hand with the girdle of Cassiopeia, or on the opposite side to that whereon the star in the Great Bear's rump is at that time; then draw a line by the edge of the ruler, and it will be a true meridian line.

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To find the exact time of noon.

A meridian line being by either of these methods exactly drawn, the time when the sun or any other of the celestial bodies is exactly in the meridian may be found by a common quadrant, placing the edge of it along the line, and observing when the sun or other luminary can be seen exactly through its two sights, and noting exactly the time; which, supposing the luminary viewed to be the sun, will be exactly noon, or 12 o'clock; but as the apparent diameter of the sun is pretty large, it ought to be known exactly when his centre is in the meridian, which will be some short space after his western limb has arrived at it, and before his eastern limb come thither. It will be proper, therefore, to observe exactly the time of the two limbs being seen through the sights of the quadrant; and the half of the difference between these times added to the one or subtracted from the other, will give the exact time when the sun's centre is in the meridian. What we say with regard to the sun, is also applicable to the moon; but not to the stars, which have no sensible diameter. To render this more intelligible, the following short description of the quadrant, and method of taking the altitudes of celestial bodies by it, is subjoined.

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To take the altitudes of the celestial bodies.

Let HOX (fig. 195.) be a horizontal line, supposed to be extended from the eye at A to X, where the sky and earth seem to meet at the end of a long and level plain: and let S be the sun. The arc XY will be the sun's height above the horizon at X, and is found by the instrument EDC, which is a quadrantal board, or plate of metal, divided into 90 equal parts or degrees on its limb DPC; and has a couple of little brass plates, as *a* and *b*, with a small hole in each of them, called *sight-holes*, for looking through, parallel to the edge of the quadrant whereon they stand. To the centre E is fixed one end of a thread F, called the *plumb-line*, which has a small weight or plummet P fixed to its other end. Now, if an observer holds the quadrant upright, without inclining it to either side, and so that the horizon at X is seen through the sight-holes *a* and *b*, the plumb-line will cut or hang over the beginning of the degrees at o, in the edge EC; but if he elevates the quadrant so as to look through the sight-holes at any part of the heavens, suppose to the sun at S; just so many degrees as he elevates the sight-hole *b* above the horizontal line HOX, so many degrees will the plumb-line cut in the limb CP of the quadrant. For, let the observer's eye at A be in the centre of the celestial arc XYV (and he may be said to be in the centre of the sun's apparent and diurnal orbit, let him be on what part of the earth he will), in which arc the sun is at that time, suppose 25 degrees high, and let the observer hold the quadrant so that he may see the sun through the sight-holes; the plumb-line freely playing on the quadrant will cut the 25th degree in the limb CP, equal to the number of degrees of the sun's altitude at the time of observation. (N. B. Whoever looks at the sun, must have a smoked glass before his eyes, to save them from hurt. The better way is, not to look at the sun through the sight-holes, but to hold the quadrant facing the eye, at a little distance, and so that, the sun shining through one hole, the ray may be seen to fall on the other.)

380
Difference between solar and sidereal days.

By observation made in the manner above directed, it is found, that the stars appear to go round the earth in 23 hours 56 minutes 5 seconds, and the sun in 24 hours: so that the stars gain three minutes 56 seconds upon the sun every day, which amounts to one diurnal revolution in a year; and therefore, in 365 days as measured by the returns of the sun to the meridian, there are 366 days as measured by the stars returning to it: the former are called *solar days*, and the latter *sidereal*.

If the earth had only a diurnal motion, without an annual, any given meridian would revolve from the sun to the sun again in the same quantity of time as from any star to the same star again; because the sun would never change his place with respect to the stars. But, as

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as the earth advances almost a degree eastward in its orbit in the time that it turns eastward round its axis, whatever star passes over the meridian on any day with the sun, will pass over the same meridian on the next day when the sun is almost a degree short of it; that is, 3 minutes 56 seconds sooner. If the year contained only 360 days, as the ecliptic does 360 degrees, the sun's apparent place, so far as his motion is equable, would change a degree every day; and then the sidereal days would be just 4 minutes shorter than the solar.

Let ABCDEFGHIKLM (fig. 179.) be the earth's orbit, in which it goes round the sun every year, according to the order of the letters, that is, from west to east; and turns round its axis in the same way from the sun to the sun again in every 24 hours. Let S be the sun, and R a fixed star at such an immense distance, that the diameter of the earth's orbit bears no sensible proportion to that distance. Let N*m* be any particular meridian of the earth, and N a given point or place upon that meridian when the earth is at A, the sun S hides the star R, which would always be hid if the earth never removed from A; and consequently, as the earth turns round its axis, the point N would always come round to the sun and star at the same time. But when the earth has advanced, suppose a twelfth part of its orbit, from A to B, its motion round its axis will bring the point N a twelfth part of a natural day, or two hours, sooner to the star than to the sun; for the angle of NB*n* is equal to the angle ASB: and therefore any star, which comes to the meridian at noon with the sun when the earth is at A, will come to the meridian at 10 in the forenoon when the earth is at B. When the earth comes to C, the point N will have the star on its meridian at 8 in the morning, or four hours sooner than it comes round to the sun: for it must revolve from N to *n*, before it has the sun in its meridian. When the earth comes to D, the point N will have the star on its meridian at 6 in the morning; but that point must revolve six hours more from N to *n*, before it has mid-day by the sun; for now the angle ASD is a right angle, and so is ND*n*; that is, the earth has advanced 90 degrees in its orbit, and must turn 90 degrees on its axis to carry the point N from the star to the sun: for the star always comes to the meridian when N*m* is parallel to RSA; because DS is but a point in respect of RS. When the earth is at E, the star comes to the meridian at 4 in the morning; at F, at two in the morning; and at G, the earth having gone half round its orbit, N points to the star R at midnight, it being then directly opposite to the sun; and therefore, by the earth's diurnal motion, the star comes to the meridian 12 hours before the sun. When the earth is at H, the star comes to the meridian at 10 in the evening; at I, it comes to the meridian at 8, that is, 16 hours before the sun; at K, 18 hours before him; at L, 20 hours; at M, 22; and at A, equally with the sun again.

381 Sidereal year contains 366 days.

Thus it is plain, than an absolute turn of the earth on its axis (which is always completed when any particular meridian comes to be parallel to its situation at any time of the day before) never brings the same meridian round from the sun to the sun again; but that the earth requires as much more than one turn on its axis to finish a natural day, as it has gone forward in that time; which, at a mean state, is a 365th part of a circle. Hence, in 365 days, the earth turns 366 times round its axis; and therefore, as a turn of the earth on its axis completes a sidereal day, there must be one sidereal day more in a year than the number of solar days, be the number what it will, on the earth or any other planet. One turn being lost with respect to the number of solar days in a year, by the planet's going round the sun; just as it would be lost to a traveller, who, in going round the earth, would lose one day by following the apparent diurnal motion of the sun; and consequently would reckon one day less at his return (let him take what time he would to go round the earth) than those who remained all the while at the place from which he set out. So if there were two earths revolving equally on their axes, and if one remained at A until the other had gone round the sun from A to A again, that earth which kept its place at A would have its solar and sidereal days always of the same length; and so would have one solar day more than the other at its return. Hence, if the earth turned but once round its axis in a year, and if that turn was made the same way as the earth goes round the sun, there would be continual day on one side of the earth, and continual night on the other.

382 Inequality of solar time.

The earth's motion on its axis being perfectly uniform, and equal at all times of the year, the sidereal days are always precisely of an equal length; and so would the solar or natural days be, if the earth's orbit were a perfect circle, and its axis perpendicular to its orbit. But the earth's diurnal motion on an inclined axis, and its annual motion in an elliptic orbit, cause the sun's apparent motion in the heavens to be unequal: for sometimes he revolves from the meridian to the meridian again in somewhat less than 24 hours, shown by a well-regulated clock; and at other times in somewhat more: so that the time shown by an equal going clock and a true sun-dial is never the same but on the 15th of April, the 16th of June, the 31st of August, and the 24th of December. The clock, if it goes equably and true all the year round, will be before the sun from the 24th of December till the 15th of April; from that time till the 16th of June, the sun will be before the clock; from the 16th of June till the 31st of August, the clock will be again before the sun; and from thence to the 24th of December, the sun will be faster than the clock.

393 Equation of time explained.

As the equation of time, or difference between the time shown by a well-regulated clock and a true sun-dial, depends upon two causes, namely, the obliquity of the ecliptic, and the unequal motion of the earth in it, we shall first explain the effects of these causes separately considered, and then the united effects resulting from their combination.

The earth's motion on its axis being perfectly equable, or always at the same rate, and the plane of the equator being perpendicular to its axis, it is evident that in equal times equal portions of the equator pass over the meridian; and so would equal portions of the ecliptic, if it were parallel to, or coincident with, the equator. But, as the ecliptic is oblique to the equator, the equable motion of the earth carries unequal portions of the ecliptic over the meridian in equal times, the difference being proportionate to the obliquity; and as some parts of the ecliptic are much

more

more oblique than others, those differences are unequal among themselves. Therefore, if two suns should start from the beginning either of Aries or Libra, and continue to move through equal arcs in equal times, one in the equator and the other in the ecliptic, the equatorial sun would always return to the meridian in 24 hours time, as measured by a well regulated clock: but the sun in the ecliptic would return to the meridian sometimes sooner and sometimes later than the equatorial sun; and only at the same moments with him on four days of the year; namely, the 20th of March, when the sun enters Aries; the 21st of June, when he enters Cancer; the 23d of September, when he enters Libra; and the 21st of December, when he enters Capricorn; and to this fictitious sun the motion of a well-regulated clock always answers.

Fig. 180. Let Z ♈ *z* ♎ be the earth; ZFR*z*, its axis; *abcde*, &c. the equator; ABCDE, &c. the northern half of the ecliptic from ♈ to ♎ on the side of the globe next the eye; and MNOP, &c. the southern half on the opposite side from ♎ to ♈. Let the points at A, B, C, D, E, F, &c. quite round from ♈ to ♈ again bound equal portions of the ecliptic, gone through in equal times by the real sun; and those at *a*, *b*, *c*, *d*, *e*, *f*, &c. equal portions of the equator described in equal times by the fictitious sun; and let Z ♈ *z* be the meridian.

As the real sun moves obliquely in the ecliptic, and the fictitious sun directly in the equator, with respect to the meridian; a degree, or any number of degrees, between ♈ and F on the ecliptic, must be nearer the meridian Z ♈ *z*, than a degree, or any corresponding number of degrees, on the equator from ♈ to *f*; and the more so, as they are the more oblique: and therefore the true sun comes sooner to the meridian every day whilst he is in the quadrant ♈ F, than the fictitious sun does in the quadrant ♈ *f*; for which reason, the solar noon precedes noon by the clock, until the real sun comes to F, and the fictitious to *f*; which two points, being equidistant from the meridian, both suns will come to it precisely at noon by the clock.

Whilst the real sun describes the second quadrant of the ecliptic FGHIKL from Cancer to ♎, he comes later to the meridian every day than the fictitious sun moving through the second quadrant of the equator from *f* to ♎; for the points at G H, I, K, and L, being farther from the meridian, their corresponding points at *g*, *h*, *i*, and *l*, must be later of coming to it: and as both suns come at the same moment to the point ♎ they come to the meridian at the moment of noon by the clock.

In departing from Libra, through the third quadrant, the real sun going through MNOPQ towards ♑ at R, and the fictitious sun through *mnopq* towards *r*, the former comes to the meridian every day sooner than the latter, until the real sun comes to ♑, and the fictitious to *r* and then they come both to the meridian at the same time.

Lastly, as the real sun moves equably thro' STUVW, from ♑ towards ♈; and the fictitious sun thro' *stuvw*, from *r* towards ♈, the former comes later every day to the meridian than the latter, until they both arrive at the point ♈, and then they make it noon at the same time with the clock.

Having explained one cause of the difference of time shown by a well-regulated clock and a true sun-dial, and considered the sun, not the earth, as moving in the ecliptic; we now proceed to explain the other cause of this difference, namely, the inequality of the sun's apparent motion, which is showed in summer, when the sun is farthest from the earth, and swiftest in winter when he is nearest to it. But the earth's motion on its axis is equable all the year round, and is performed from west to east; which is the way that the sun appears to change his place in the ecliptic.

If the sun's motion were equable in the ecliptic, the whole difference between the equal time as shown by the clock, and the unequal time as shown by the sun, would arise from the obliquity of the ecliptic. But the sun's motion sometimes exceeds a degree in 24 hours, though generally it is less: and when his motion is slowest, any particular meridian will revolve sooner to him than when his motion is quickest; for it will overtake him in less time when he advances a less space than when he moves through a larger.

Now, if there were two suns moving in the plane of the ecliptic, so as to go round it in a year; the one describing an equal arc every 24 hours, and the other describing sometimes a less arc in 24 hours, and at other times a larger, gaining at one time of the year what is lost at the opposite; it is evident, that either of these suns would come sooner or later to the meridian than the other, as it happened to be behind or before the other; and when they were both in conjunction, they would come to the meridian at the same moment.

As the real sun moves unequably in the ecliptic, let us suppose a fictitious sun to move equably in a circle coincident with the plane of the ecliptic. Let ABCD (fig. 181.) be the ecliptic or orbit in which the real sun moves, and the dotted circle *abcd* the imaginary orbit of the fictitious sun: each going round in a year according to the order of letters, or from west to east. Let HIKL be the earth turning round its axis the same way every 24 hours; and suppose both suns to start from A and *a*, in a right line with the plane of the meridian EH, at the same moment: the real sun at A, being then at his greatest distance from the earth, at which time his motion is slowest; and the fictitious sun at *a*, whose motion is always equable, because his distance from the earth is supposed to be always the same. In the time that the meridian revolves from H to H again, according to the order of the letters HIKL, the real sun has moved from A to F; and the fictitious with a quicker motion from *a* to *f*, through a large arc: therefore the meridian EH will revolve sooner from H to *h* under the real sun at F, than from H E to *k* under the fictitious sun at *f*; and consequently it will then be noon by the sun-dial sooner than by the clock.

As the real sun moves from A towards C, the swiftness of his motion increases all the way to C, where it is at the quickest. But notwithstanding this, the fictitious sun gains so much upon the real, soon after his departing from A, that the increasing velocity of the real sun does not bring him up with the equally moving fictitious sun till the former comes to C, and the latter to *c*, when each has gone half round its respective orbit; and then being in conjunction, the meridian EH, revolving to EK, comes to both suns at the same time, and

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and therefore it is noon by them both at the same moment.

But the increased velocity of the real sun, now being at the quickest, carries him before the fictitious one; and therefore, the same meridian will come to the fictitious sun sooner than to the real: for whilst the fictitious sun moves from *c* to *g*, the real sun moves through a greater arc from C to G: consequently the point K has its noon by the clock when it comes to *k*, but not its noon by the sun till it comes to *l*. And although the velocity of the real sun diminishes all the way from C to A, and the fictitious sun by an equable motion is still coming nearer to the real sun, yet they are not in conjunction till the one comes to A and the other to *a*, and then it is noon by them both at the same moment.

Thus it appears, that the solar noon is always later than noon by the clock whilst the sun goes from C to A; sooner, whilst he goes from A to C; and at these two points the sun and clock being equal, it is noon by them both at the same moment.

The point A is called the sun's *apogee*, because when he is there he is at his greatest distance from the earth; the point C his *perigee*, because when in it he is at his least distance from the earth: and a right line, as AEC, drawn through the earth's centre, from one of the points to the other, is called the *line of the Apsides*.

The distance that the sun has gone in any time from his apogee (not the distance he has to go to it, though ever so little) is called his *mean anomaly*, and is reckoned in signs and degrees, allowing 30 degrees to a sign. Thus, when the sun has gone suppose 174 degrees from his apogee at A, he is said to be 5 signs 14 degrees from it, which is his mean anomaly; and when he is gone suppose 355 degrees from his apogee, he is said to be 11 signs 25 degrees from it, although he be but 5 degrees short of A in coming round to it again.

From what was said above, it appears, that when the sun's anomaly is less than 6 signs, that is, when he is any where between A and C, in the half ABC of his orbit, the solar noon precedes the clock noon; but when his anomaly is more than 6 signs, that is, when he is any where between C and A, in the half CDA of his orbit, the clock noon precedes the solar. When his anomaly is 0 signs 0 degrees, that is, when he is in his apogee at A; or 6 signs 0 degrees, which is when he is in his perigee at C; he comes to the meridian at the moment that the fictitious sun does, and then it is noon by them both at the same instant.

Sect. VIII. *Of calculating the Distances, Magnitudes, &c. of the Sun, Moon, and Planets.*

384

To find the moon's horizontal parallax.

This is accomplished by finding out the horizontal parallax of the body whose distance you desire to know; that is, the angle under which the semidiameter of the earth would appear provided we could see it from that body; and this is to be found out in the following manner.

Let BAG (fig. 171.) be one half of the earth, AC its semidiameter, S the sun, *m* the moon, and EKOL a quarter of the circle described by the moon in revolving from the meridian to the meridian again. Let CRS be the rational horizon of an observer at A, extended to the sun in the heavens; and HAO, his sensible horizon extended to the moon's orbit. ALC is the angle under which the earth's semidiameter AC is seen from the moon at L; which is equal to the angle OAL, because the right lines AO and CL which include both these angles are parallel. ASC is the angle under which the earth's semidiameter AC is seen from the sun at S: and is equal to the angle OA*f*, because the lines AO and CRS are parallel. Now, it is found by observation, that the angle OAL is much greater than the angle OA*f*; but OAL is equal to ALC, and OA*f* is equal to ASC. Now as ASC is much less than ALC, it proves that the earth's semidiameter AC appears much greater as seen from the moon at L than from the sun at S; and therefore the earth is much farther from the sun than from the moon. The quantities of these angles may be determined by observation in the following manner.

Let a graduated instrument, as DAE (the larger the better), having a moveable index with sight-holes, be fixed in such a manner, that its plane surface may be parallel to the plane of the equator, and its edge AD in the meridian: so that when the moon is in the equinoctial, and on the meridian ADE, she may be seen through the sight-holes when the edge of the moveable index cuts the beginning of the divisions at o, on the graduated limb DE; and when she is so seen, let the precise time be noted. Now as the moon revolves about the earth from the meridian to the meridian again in about 24 hours 48 minutes, she will go a fourth part round it in a fourth part of that time, viz. in 6 hours 12 minutes, as seen from C, that is, from the earth's centre or pole. But as seen from A, the observer's place on the earth's surface, the moon will seem to have gone a quarter round the earth when she comes to the sensible horizon at O; for the index through the sights of which she is then viewed will be at *d*, 90 degrees from D, where it was when she was seen at E. Now let the exact moment when the moon is seen at O (which will be when she is in or near the sensible horizon) be carefully noted (G), that it may be known in what time she has gone from E to O; which time subtracted from six hours 12 minutes (the time of her going from E to L) leaves the time of her going from O to L, and affords an easy method for finding the angle OAL (called *the moon's horizontal parallax*, which is equal to the angle ALC) by the following analogy: As the time of the moon's describing the arc EO is to 90 degrees, so is 6 hours 12 minutes to the degrees of the arc D *d* E, which measures the angle EAL; from which subtract 90 degrees, and there remains the angle OAL, equal to the angle ALC, under which the earth's semidiameter AC is seen from the the moon. Now, since all the angles of a right-lined triangle are equal to 180 degrees, or to two right angles,

(G) Here proper allowance must be made for the refraction, which being about 34 minutes of a degree in the horizon, will cause the moon's centre to appear 34 minutes above the horizon when her centre is really in it.

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angles, and the sides of a triangle are always proportional to the sines of the opposite angles, say, by the Rule of Three, as the sine of the angle ALC at the moon L, is to its opposite side AC, the earth's semidiameter, which is known to be 3985 miles; so is radius, viz. the sine of 90 degrees, or of the right angle ACL to its opposite side AL, which is the moon's distance at L from the observer's place at A on the earth's surface; or, so is the sine of the angle CAL to its opposite side CL, which is the moon's distance from the earth's centre, and comes out at a mean rate to be 240,000 miles. The angle CAL is equal to what OAL wants of 90 degrees.

385 Another method.

Other methods have been fallen upon for determining the moon's parallax; of which the following is recommended as the best, by Mr Fergusson, though hitherto it has not been put in practice. Let two observers be placed under the same meridian, one in the northern hemisphere and the other in the southern, at such a distance from each other, that the arc of the celestial meridian included between their two zenith's may be at least 80 or 90 degrees. Let each observer take the distance of the moon's centre from his zenith, by means of an exceeding good instrument, at the moment of her passing the meridian: and these two zenith distances of the moon together, and their excess above the distance between the two zeniths, will be the distance between the two apparent places of the moon. Then, as the sum of the natural sines of the two zenith-distances of the moon is to radius, so is the distance between her two apparent places to her horizontal parallax: which being found, her distance from the earth's centre may be found by the analogy mentioned above.

Thus, in fig. 199. let VECQ be the earth, M the moon, and *Zbaz* an arc of the celestial meridian. Let V be Vienna, whose latitude EV is 48° 20′ north; and C the Cape of Good Hope, whose latitude EC is 34° 30′ south: both which latitudes we suppose to be accurately determined beforehand by the observers. As these two places are on the same meridian *n*VEC*s*, and in different hemispheres, the sum of their latitudes 82° 50′ is their distance from each other. Z is the zenith of Vienna, and z the zenith of the Cape of Good Hope; which two zeniths are also 82° 50′ distant from each other, in the common celestial meridian Zz. To the observer at Vienna, the moon's centre will appear at *a* in the celestial meridian; and at the same instant, to the observer at the Cape, it will appear at *b*. Now suppose the moon's distance Z *a* from the zenith of Vienna to be 38° 1′ 53″, and her distance *z b* from the zenith of the Cape of Good Hope to be 46° 4′ 41″: the sum of these two zenith distances (*Za*+*zb*) is 84° 6′ 34″; from which subtract 82° 50″, the distance of Zz between the zeniths of these two places, and there will remain 1° 16′ 34″ for the arc *ba*, or distance between the two apparent places of the moon's centre, as seen from V and from C. Then, supposing the tabular radius to be 10,000,000, the natural sine of 38° 1. 53″ (the arc *Za*) is 6,160,816, and the natural sine of 46′ 4′ 41″ the arc *zb*) is 7,202,821: the sum of both these sines is 13,363,637. Say therefore, As 13,363,637 is to 10,000,000, so is 1° 16′ 34″ to 57′ 18″, which is the moon's horizontal parallax.

If the two places of observation be not exactly under the same meridian, their difference of longitude must be accurately taken, that proper allowance may be made for the moon's declination whilst she is passing from the meridian of the one to the meridian of the other.

The parallax, and consequently the distance and bulk, of any primary planet, might be found in the above manner, if the planet was near enough to the earth, so as to make the difference of its two apparent places sufficiently sensible: but the nearest planet is too remote for the accuracy required.

386 Parallax of the sun difficult to be found.

The sun's distance from the earth might be found the same way, though with more difficulty, if his horizontal parallax, or the angle OAS equal to the angle ASC (fig. 171.), were not small so as to be hardly perceptible, being found in this way to be scarce 10 seconds of a minute, or the 360th part of a degree. Hence all astronomers, both ancient and modern have failed in taking the sun's parallax to a sufficient degree of exactness; but as some of the methods used are very ingenious, and show the great acuteness and sagacity of the ancient astronomers, we shall here give an account of them. The first method was invented by Hipparchus; and has been made use of by Ptolemy and his followers, and many other astronomers. It depends on an observation of an eclipse of the moon: And the principles on which it is founded, are, 1*st*, In a lunar eclipse, the horizontal parallax of the sun is equal to the difference between the apparent semidiameter of the sun, and half the angle of the conical shadow; which is easily made out in this manner. Let the circle AFG (fig. 87.) represent the sun, and DHC the earth; let DHM be the shadow, and DMC the half angle of the cone. Draw from the centre of the sun the right line SD touching the earth, and the angle DS is the apparent semidiameter of the earth, seen from the sun, which is equal to the horizontal parallax of the sun; and the angle ADS is the apparent semidiameter of the sun seen from the earth: The external angle ADS is equal to the two internals DMS and DSM, by the 32d Prop. Elem. I. And therefore the angle DSM, or DSC, is equal to the difference of the angles ADS and DMS. 2*dly*, Half the angle of the cone is equal to the difference of the horizontal parallax of the moon and the apparent semidiameter of the shadow, seen from the earth at the distance of the moon. For let CTE be the earth, CME the shadow, which at the distance of the moon being cut by a plane, the section will be the circle FLK, whose semidiameter is FG, and is seen from the centre of the earth under the angle FTG. But by the 32d Prop. Elem. I. the angle CFT is equal to the two internals FMT and FTM. Wherefore the angle FMT is the difference of the two angles CFT and GTF: But the angle CFT is the angle under which the semidiameter of the earth is seen from the moon, and this is equal to the horizontal parallax of the moon; and the angle GTF is the apparent semidiameter of the shadow seen from the earth's centre. It is therefore evident that the half angle of the cone is equal to the difference of the horizontal parallax of the moon, and the apparent semidiameter of the shadow seen from the earth. Wherefore, if to the apparent semidiameter of the sun there be added the apparent semidiameter of the shadow, from the sum you take away the horizontal parallax of the moon, there will

387 Hipparchus's method of finding it.

Fig. 89.

Fig. 173.

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will remain the horizontal parallax of the sun; which therefore, if these were accurately known, would be likewise known accurately: But none of them can be so exactly and nicely obtained, as to be sufficient for determining the parallax of the sun; for very small errors, which cannot be easily avoided in measuring these angles will produce very great errors in the parallax; and there will be a prodigious difference in the distances of the sun when drawn from these parallaxes. For example, Suppose the horizontal parallax of the moon to be 60′ 15″, the semidiameter of the sun 16′, and the semidiameter of the shadow 44′ 30″, we shall conclude from thence, that the parallax of the sun was 15″, and his distance from the earth about 13,700 semidiameters of the earth. But if there be an error committed in determining the semidiameter of the shadow, of 12″ in defect (and certainly the semidiameter of the shadow cannot be had so precisely as not to be liable to such an error), that is, if instead of 44′ 30″ we put 44′ 18″ for the apparent diameter of the shadow, all the others remaining as before, we shall have the parallax of the sun 3″, and its distance from the earth almost 70,000 semidiameters of the earth, which is five times more than what it was by the first position. But if the fault were in excess, or the diameter of the shadow exceeded the true by 12″, so that we should put in 44′ 42″, the parallax would arise to 27″, and the distance of the sun only 7700 of the earth's semidiameters; which is nine times less than what it comes to by a like error in defect. If an error in defect was committed of 15″, which is still but a small mistake, the sun's parallax would be equal to nothing, and his distance infinite. Wherefore, since from so small mistakes the parallax and distance of the sun vary so much, it is plain that the distance of the sun cannot be obtained by this method.

388 This method insufficient.

389 Aristarchus's method.

Since therefore, the angle that the earth's semidiameter subtends at the sun is so small that it cannot be determined by any observation, Aristarchus Samius, an ancient and great philosopher and astronomer, contrived a very ingenious way for finding the angle which the semidiameter of the moon's orbit subtends when seen from the sun: This angle is about 60 times bigger than the former, subtended only to the earth's semidiameter. To find this angle, he lays down the following principles.

From the phases of the moon, it hath been demonstrated, that if a plane passed through the moon's centre, to which the line joining the sun and moon's centre was perpendicular, this plane would divide the illuminated hemisphere of the moon from the dark one: And therefore, if this plane should likewise pass through the eye of a spectator on the earth, the moon would appear bisected, or like half a circle; and a right line, drawn from the earth to the centre of the moon, would be in the plane of illumination, and consequently would be perpendicular to the right line which joins the centres of the sun and moon. Let S be be the sun, and T the earth, ALq a quadrant of the moon's orbit; and let the line SL, drawn from the sun, touch the orbit of the moon in L; the angle TLS will be a right angle: And therefore, when the moon is seen in L, it will appear bisected, or just half a circle. At the same time take the angle LTS, the elongation of the moon from the sun, and then we shall have the angle LST, its complement to a right angle. But we have the side TL, by which we can find the side ST, the distance of the sun from the earth.

Fig. 90.

390 This method insufficient.

But the difficult point is to determine exactly the moment of time when the moon is bisected, or in its true dichotomy; for there is a considerable space of time both before and after the dichotomy, nay even in the quadrature, when the moon will appear bisected, or half a circle; so that the exact moment of bisection cannot be known by observation, as experience tells us: And consequently, the true distance of the sun from the earth cannot be obtained by this method.

391 Ricciolus's method.

Since the moment in which the true dichotomy happens is uncertain, but it is certain that it happens before the quadrature; Ricciolus takes that point of time which is in the middle, between the time that the phasis begins to be doubtful whether it be bisected or not, and the time of quadrature: but he had done better, if he had taken the middle point between the time when it becomes doubtful whether the moon's side is concave or straight, and the time again when it is doubtful whether it is straight or convex; which point of time is after the quadrature: and if he had done this, he would have found the sun's distance a great deal more than he has made it.

392 Another by Dr Keil.

There is no need to confine this method to the phasis of a dichotomy, or bisection, for it can be as well performed when the moon has any other phasis bigger or less than a dichotomy: for observe by a very good telescope, with a micrometer, the phasis of the moon, that is, the proportion of the illuminated part of the diameter to the whole; and at the same moment of time take her elongation from the sun: The illuminated part of the diameter, if it be less than the semidiameter, is to be subducted from the semidiameter; but if it be greater, the semidiameter is to be subducted from it, and mark the residue: then say, As the semidiameter of the moon is to the residue, so is the radius to the sine of an angle, which is therefore found: this angle added to, or subtracted from, a right angle, gives the exterior angle of the triangle at the moon: but we have the angle at the earth, which is the elongation observed; which therefore being subducted from the exterior angle, leaves the angle at the sun. And in the triangle SLT, having all the angles and one side LT, we can find the other side ST, the distance of the sun from the earth. But it is almost impossible to determine accurately the quantity of the lunar phasis, so that there may not be an error of a few seconds committed; and consequently, we cannot by this method find precisely enough the true distance of the sun. However, from such observations, we are sure, that the sun is above 7000 semidiameters of the earth distant from us. Since therefore the true distance of the sun can neither be found by eclipses nor by the phases of the moon, the astronomers are forced to have recourse to the parallaxes of the planets that are next to us, as Mars and Venus, which are sometimes much nearer to us than the sun is. Their parallaxes they endeavour to find by some of the methods above explained; and if these parallaxes were known, then the parallax and distance of the sun, which cannot directly by any observations be attained, would easily be deduced from them. For from the theory of the motions of the earth and planets, we know at any time the proportion of

393 All these methods insufficient.

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of the distances of the sun and planets from us; and the horizontal parallaxes are in a reciprocal proportion to these distances. Wherefore, knowing the parallax of a planet we may from thence find the parallax of the sun.

394 Another method from the parallax of Mars.

Mars, when he is in an achronycal position, that is opposite to the sun, is twice as near to us as the sun is; and therefore his parallax will be twice as great. But Venus, when she is in her inferior conjunction with the sun, is four times nearer to us than he is, and her parallax is greater in the same proportion: Therefore, though the extreme smallness of the sun's parallax renders it unobservable by our senses, yet the parallaxes of Mars or Venus, which are twice or four times greater, may become sensible. The astronomers have bestowed much pains in finding out the parallax of Mars; but some time ago Mars was in his opposition to the sun, and also in his perihelion; and consequently in his nearest approach to the earth: And then he was most accurately observed by two of the most eminent astronomers of our age, who have determined his parallax to have been scarce 30 seconds; from whence it was inferred, that the parallax of the sun is scarce 11 seconds, and his distance about 19,000 semidiameters of the earth.

395 From that of Venus.

As the parallax of Venus is still greater than that of Mars, Dr Halley proposed a method by it of finding the distance of the sun to within a 500th part of the whole. The times of observation were at her transits over the sun in 1761 and 1769. At these times the greatest attention was given by astronomers, but it was found impossible to observe the exact times of immersion and emersion with such accuracy as had been expected; so that the matter is not yet determined so exactly as could be wished. The method of calculating the sun's distance by means of these transits is as follows.

In fig. 91. let DBA be the earth, V Venus, and TSR the eastern limb of the sun. To an observer at B, the point *t* of that limb will be on the meridian, its place referred to the heaven will be at E, and Venus will appear just within it at S. But at the same instant, to an observer at A, Venus is east of the sun, in the right line AVF; the point *t* of the sun's limb appears at *e* in the heaven; and if Venus were then visible she would appear at F. The angle CVA is the horizontal parallax of Venus, which we seek; and is equal to the opposite angle FVE, whose measure is the arc FE. ASC is the sun's horizontal parallax, equal to the opposite angle *e* SE, whose measure is the arc *e* E; and FA*e* (the same as VA*v*) is Venus's horizontal parallax from the sun, which may be found by observing how much later in absolute time her total ingress on the sun is, as seen from A than as seen from B, which is the time she takes to move from V to *v* in her orbit OV*v*. Fig. 6.

It appears by the tables of Venus's motion and the sun's, that at the time of her transit in 1761 she moved 4′ of a degree on the sun's disk in 60 minutes of time: and consequently 4″ of a degree in one minute of time.

Now, let us suppose that A is 90° west of B, so that when it is noon at B it will be six in the morning at A; that the total ingress as seen from B is at one minute past 12, but that as seen from A it is at seven minutes 30 seconds past six; deduct six hours for the difference of meridians of A and B, and the remainder will be six minutes 30 seconds for the time by which the total ingress of Venus on the sun at S, is later as seen from A than as seen from B; which time being converted into parts of a degree is 26″, or the arc F*e* of Venus's horizontal parallax from the sun; for, as 1 minute of time is to 4 seconds of a degree, so is $6\frac{1}{2}$ minutes of time to 26 seconds of a degree.

The times in which the planets perform their annual revolutions about the sun are already known by observation.—From these times, and the universal power of gravity by which the planets are retained in their orbits, it is demonstrable, that if the earth's mean distance from the sun be divided into 100,000 equal parts, Mercury's mean distance from the sun must be equal to 38,710 of these parts—Venus's mean distance from the sun to 72,333——Mars's mean distance, 152,369—Jupiter's, 520,096—and Saturn's 954,006. Therefore when the number of miles contained in the mean distance of any planet from the sun is known, we can by these proportions find the mean distance in miles of all the rest.

At the time of the abovementioned transit, the earth's distance from the sun was 1015 (the mean distance being here considered as 1000), and Venus's distance from the sun 726 (the mean distance being considered as 723), which differences from the mean distances arise from the elliptical figure of the planets orbits—Subtracting 726 parts from 1015, there remain 289 parts for Venus's distance from the earth at that time.

Now, since the horizontal parallaxes of the planets are inversely as their distances from the earth's centre, it is plain, that as Venus was between the earth and the sun on the day of her transit, and consequently her parallax at that time greater than the sun's, if her horizontal parallax was then ascertained by observation, the sun's horizontal parallax might be found, and consequently his distance from the earth.—Thus, suppose Venus's horizontal parallax was found to be 36″.3480, then, As the sun's distance 1015 is to Venus's distance 289, so is Venus's horizontal parallax 36″.3480 to the sun's horizontal parallax 10″.3493 on the day of her transit. And the difference of these two parallaxes, viz. 25″.9987 (which may be esteemed 26″), will be the quantity of Venus's horizontal parallax from the sun.

To find the sun's horizontal parallax at the time of his mean distance from the earth, say, As 1000 parts of the sun's mean distance from the earth's centre, is to 1015, his distance therefrom on the day the transit, so is 10″.3493, his horizontal parallax on that day, to 10″.5045, his horizontal parallax at the time of his mean distance from the earth's centre.

396 Method of computing the sun's distance from his parallax.

The sun's parallax being thus (or any other way supposed to be) found, at the time of his mean distance from the earth, we may find his true distance therefrom, in semidiameters of the earth, by the following analogy. As the sine (or tangent of so small an arc as that) of the sun's parallax 10″.5045 is to radius, so is unity or the earth's semidiameter to the number of semidiameters of the earth that the sun is distant from its centre; which number, being multiplied by 3985, the number of miles contained in the earth's semidiameter, will give the number of miles by which the sun is distant from the earth's center.

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Then, As 100,000, the earth's mean distance from the sun in parts, is to 38,710, Mercury's mean distance from the sun in parts, so is the earth's mean distance from the sun in miles to Mercury's mean distance from the sun in miles.—And,

397 Distances of the other planets, how found.

As 100,000 is to 72,333, so is the earth's mean distance from the sun in miles to Venus's mean distance from the sun in miles.—Likewise,

As 100,000 is to 152,369, so is the earth's mean distance from the sun in miles to Mars's mean distance from the sun in miles.—Again.

As 100,000 is to 520,096, so is the earth's mean distance from the sun in miles to Jupiter's mean distance from the sun in miles. Lastly,

As 100,000 is to 954,006, so is the earth's mean distance from the sun in miles to Saturn's mean distance from the sun in miles.

And thus, by having found the distance of any one of the planets from the sun, we have sufficient data for finding the distances of all the rest. And then from their apparent diameters at these known distances, their real diameters and bulks may be found. According to the calculations made from the transit in 1769, we have given the distance of each of the primary and secondary planets from one another, and from the sun, in fig. 119. In fig. 153. their proportional bulks are shown, according to former culculations by Mr Ferguson; and in fig. 18. their relative magnitudes according to the latest calculations by Mr Dunn. The proportional distances of the satellites of Jupiter and Saturn, with the magnitudes of the sun, and orbit of our moon, by Mr Ferguson, are represented fig. 186.

398 Distances of the fixed stars immeasurable.

With regard to the fixed stars, no method of ascertaining their distance hath hitherto been found out. Those who have formed conjectures concerning them, have thought that they were at least 400,000 times farther from us than we are from the sun.

They are said to be fixed, because they have been generally observed to keep at the same distances from each other; their apparent diurnal revolutions being caused solely by the earth's turning on its axis. They

399 Why they seem so big to our naked eye.

appear of a sensible magnitude to the bare eye, because the retina is affected not only by the rays of light which are emitted directly from them, but by many thousands more, which falling upon our eye-lids, and upon the aerial particles about us, are reflected in our eyes so strongly as to excite vibrations not only in those points of the retina where the real images of the stars are formed, but also in other points at some distance round about. This makes us imagine the stars to be much bigger than they would appear if we saw them only by the few rays which come directly from them, so as to enter our eyes without being intermixed with others. Any one may be sensible of this, by looking at a star of the first magnitude through a long narrow tube; which, though it takes in as much of the sky as would hold 1000 such stars, yet scarce renders that one visible.

The more a telescope magnifies, the less is the aperture through which the star is seen; and consequently the fewer rays it admits into the eye. Now, since the stars appear less in a telescope which magnifies 200 times, than they do to the bare eye, insomuch that they seem to be only indivisible points, it proves at once that the stars are at immense distances from us, and that they shine by their own proper light. If they shone by borrowed light, they would be as invisible without telescopes as the satellites of Jupiter are; for these satellites appear bigger when viewed with a good telescope than the largest fixed stars do.

Dr. Herschel has proposed a method of ascertaining the parallax of the fixed stars, something similar, but more complete, than that mentioned by by Galileo and others; for it is by the parallax of the fixed stars that we should be best able to determine their distance. The method pointed out by Galileo; and first attempted by Hook, Flamstead, Mollineux and Bradley, of taking distances of stars from the zenith that pass very near it, has given us a much juster idea of the immense distance of the stars, and furnished us with an approximation to the knowledge of their parallax, that is much nearer the truth than we ever had before. But Dr Herschel mentions the insufficiency of their instruments, which were similar to the present zenith sectors, the method of zenith distances being liable to considerable errors on account of refraction, the change of position of the earth's axis arising from nutation, precession of the equinoxes, and other causes, and the aberration of light. The method of his own is by means of double stars; which is exempted from these errors, and of such a nature that the annual parallax, even if it should not exceed the tenth part of a second, may still become more visible, and be ascertained, at least to a much greater degree of approximation than it has ever been done. This method is capable of every improvement which the telescope and mechanism of micrometers can furnish. The method and its theory will be seen by the following investigation, extracted from his paper on the subject. Let O, E. (fig. 164.) be two opposite points in the annual orbit, taken in the same plane with two stars *a*, *b*, of unequal magnitudes. Let the angle *a* O *b* be observed when the earth is at O, and *a* E *b* be observed when the earth is at E. From the difference of these angles, if there should be any, we may calculate the parallax of the stars, according to the theory subjoined. These two stars ought to be as near each other as possible, and also to differ as much in magnitude as we can find them.

Phil. Tran. vol. lxxii. p. 82.

Dr Herschel's theory of the annual parallax of double stars, with the method of computing from thence what is generally called the parallax of the fixed stars, or of single stars of the first magnitude, such are nearest to us, supposes, *first*, that the stars, one with another, are about the size of the sun; and, *secondly*, that the difference of their apparent magnitude is owing to their different distances; so that the star of the second, third, or fourth magnitude, is two, three, or four times as far off as one of the first. These principles, which he premises as postulata, have so great a probability in their favour, that they will hardly be objected to by those who are in the least acquainted with the doctrine of chances. Accordingly, let OE (fig. 165.) be the whole diameter of the earth's annual orbit; and let *a*, *b*, *c*, be three stars situated in the ecliptic, in such a manner that they may be seen all in one line O *a*, *b*, *c*, when the earth is at O. Let the line O *a b c* be perpendicular to OE. and draw PE parallel to *c* O: then, if O *a*, *a b*, *b c*, are equal to each other, *a* will be a star of the first magnitude, *b* of the second, and *c* of

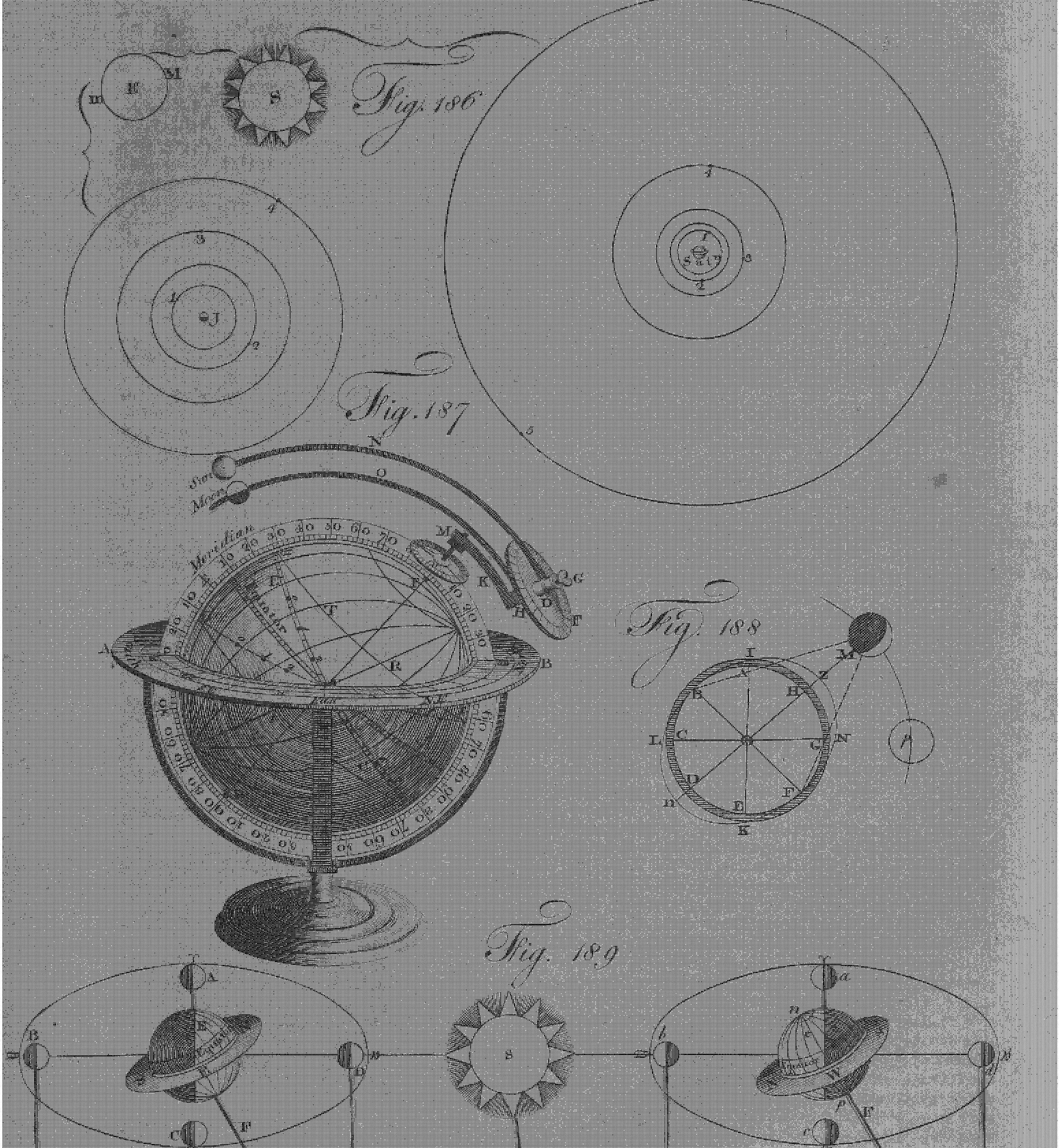
Fig. 186
Fig. 187
Fig. 188
Fig. 189
Sun
Moon
Meridian
Equator
Scot Philad:

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c of the third. Let us now ſuppoſe the angle O a E, or parallax of the whole orbit of the earth, to be 1″ of a degree; then we have P E a = O a E = 1″: and becauſe very ſmall angles, having the ſame ſubtenſe OE, may be taken to be in the inverſe ratio of the lines O a, O b, O c, &c. we ſhall have O b E = $\frac{1}{2}$″, O c E = $\frac{1}{3}$″, &c. Now when the earth is removed to E, we ſhall have P E b = E b o = $\frac{1}{2}$″, and P E a — P E b = a E b = $\frac{1}{2}$″: i. e. the ſtars a, b, will appear to be $\frac{1}{2}$″ diſtant. We alſo have P E c = E c O = $\frac{1}{3}$″, and P E a — P E c = a E c = $\frac{2}{3}$″; i. e. the ſtars a, c, will appear to be $\frac{2}{3}$″ diſtant when the earth is at E. Now, ſince we have b E P = $\frac{1}{2}$″, and c E P = $\frac{1}{3}$″, therefore b E P — c E P = b E c = $\frac{1}{2}$″ — $\frac{1}{3}$″ = $\frac{1}{6}$″; i. e. the ſtars b, c, will appear to be only $\frac{1}{6}$″ removed from each other when the earth is at E. Whence we may deduce the following expreſſion, to denote the parallax that will become viſible in the change of diſtance between the two ſtars, by the removal of the earth from one extreme of its orbit to the other. Let P expreſs the total parallax of a fixed ſtar of the firſt magnitude, M the magnitude of the largeſt of the two ſtars, m the magnitude of the ſmalleſt, and p the partial parallax to be obſerved by the change in the diſtance of a double ſtar; then will $p = \frac{m - M}{M m} P$; and p, being found by obſervation, will give us $P = \frac{p M m}{m - M}$. *E. G.* Suppoſe a ſtar of the firſt magnitude ſhould have a ſmall ſtar of the twelfth magnitude near it; then will the partial parallax we are to expect to ſee be $\frac{12 \times 1 P}{12 - 1}$, or $\frac{12}{11}$ of the total parallax of a fixed ſtar of the firſt magnitude; and if we ſhould, by obſervation, find the partial parallax between two ſuch ſtars to amount to 1″, we ſhall have the total parallax $P = \frac{1 \times 1 \times 12}{12 - 1} = 1''.0909$. If the ſtars are of the third and twenty-fourth magnitude, the partial parallax will be $\frac{24 - 3}{3 \times 24} = \frac{21}{72} P$; and if, by obſervation, p is found to be a tenth of a ſecond, the whole parallax will come out $\frac{.1 \times 3 \times 24}{24 - 3} = 0''.3428$.

Farther, ſuppoſe the ſtars being ſtill in the ecliptic, to appear in one line, when the earth is in any other part of its orbit between O and E; then will the parallax ſtill be expreſſed by the ſame algebraic formula, and one of the maxima will ſtill lie at O, the other at E; but the whole effect will be divided into two parts, which will be in proportion to each other as radius — ſine to radius + ſine of the ſtars diſtance from the neareſt conjunction or oppoſition.

When the ſtars are any where out of the ecliptic, ſituated ſo as to appear in one line O a b c perpendicular to O E, the maximum of parallax will ſtill be expreſſed by $\frac{m - M}{M m} P$; but there will ariſe another additional parallax in the conjunction and oppoſition, which will be to that which is found 90° before or after the ſun, as the ſine (S) of the latitude of the ſtars ſeen at O is to the radius (R); and the effect of this parallax will be divided into two parts; half of it lying on one ſide of the large ſtar, the other half on the other ſide of it. This latter parallax, moreover, will be compounded with the former, ſo that the diſtance of the ſtars in the conjunction and oppoſition will then be repreſented by the diagonal of a parallelogram, whereof the two ſemiparallaxes are the ſides; a general expreſſion for which will be $\sqrt{\left(\frac{m - M}{2 m M} P\right)^2 \times \frac{SS}{RR} + 1}$; for the ſtars will apparently deſcribe two ellipſes in the heavens, whoſe tranſverſe axis will be to each other in the ratio of M to m (fig. 167.), and A a, B b, C c, D d, will be the cotemporary ſituations. Now, if b Q be drawn parallel to A C, and the parallelogram b q B Q be completed, we ſhall have b Q = $\frac{1}{2}$ C A — $\frac{1}{2}$ c a = $\frac{1}{2}$ C c = $\frac{1}{2}$ p, or ſemiparallax 90° before or after the ſun, and B b may be reſolved into, or is compounded of, b Q and b q; but b q = $\frac{1}{2}$ B D — $\frac{1}{2}$ b d = the ſemiparallax in the conjunction or oppoſition. We alſo have R : S : : b Q : b q = $\frac{p S}{2 R}$; therefore the diſtance B b (or D d) = $\sqrt{\left(\frac{p}{2}\right)^2 + \left(\frac{p S}{2 R}\right)^2}$; and by ſubſtituting the value of p into this expreſſion, we obtain $\sqrt{\left(\frac{m - M}{2 M m} P\right)^2 \times \frac{S S}{RR} + 1}$, as above. When the ſtars are in the pole of the ecliptic, b q will become equal to b Q, and B b will be 7071 P $\frac{m - M}{M m}$. Again, let the ſtars be at ſome diſtance, *e. g.* 5″ from each other, and let them both be in the ecliptic. This caſe is reſolvable into the firſt; for imagine the ſtar a (fig. 166.) to ſtand at x, and in that ſituation the ſtars x, b, c, will be in one line, and their parallax expreſſed by $\frac{m - M}{M m}$ P. But the angle a E x may be taken to be equal to a O x; and as the foregoing formula gives us the angles x E b, x E c, we are to add a E x or 5″ to x E b, and we ſhall have a E b. In general, let the diſtance of the ſtars be d, and let the obſerved diſtance at E be D, then will D = $d + p$, and therefore the whole parallax of the annual orbit will be expreſſed by $\frac{D M m - d M m}{m - M} = P$.

Suppoſe the two ſtars now to differ only in latitude, one being in the ecliptic, the other, *e. g.* 5 north, when ſeen at O. This caſe may alſo be reſolved by the former; for imagine the ſtars b, c, (fig. 165.) to be elevated at right angles above the plane of the figure, ſo that a O b, or a O c, may make an angle of 5″ at O; then, inſtead of the lines O a b c, E a, E b, E c, E P, imagine them all to be planes at right angles to the figure; and it will appear that the parallax of the ſtars in longitude muſt be the ſame as if the ſmall ſtar had been without latitude. And ſince the ſtars b, c, by the motion of the earth from O to E, will not change their latitude, we ſhall have the following conſtruction for finding the diſtance of the ſtars a b, a c, at E, and from thence the parallax P. Let the triangle a b β (fig. 168.) repreſent the ſituation of the ſtars; a b is the ſubtenſe of 5″, the angle under which they are ſuppoſed to be ſeen at O. The quantity b β by the former theorem is found, $\frac{m - M}{M m}$ P, which is the partial parallax that would have been ſeen by the earth's

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earth's moving from O to E, if both stars had been in the ecliptic; but on account of the difference in latitude, it will be now represented by $a\beta$, the hypothenuse of the triangle $a\, b\, \beta$: therefore, in general, putting $a\, b = d$, and $a\, \beta = D$, we have $\sqrt{\dfrac{DD - dd \times Mm}{m - M}} = P$. Hence D being taken by observation, and d, M, and m, given, we obtain the total parallax.

If the situation of the stars differs in longitude as well as latitude, we may resolve this case by the following method. Let the triangle $a\, b\, \beta$ (fig. 169.) represent the situation of the stars, $a\, b = d$ being their distance seen at O, $a\, \beta = D$ their distance seen at E. That the change $b\, \beta$, which is produced by the earth's motion will be truly expressed by $\dfrac{m - M}{M\, m} P$ may be proved as before, by supposing the star a to have been placed at α. Now let the angle of position $b\, a\, \alpha$ be taken by a micrometer, or by any other method sufficiently exact; then, by solving the triangle $a\, b\, \alpha$, we shall have the longitudinal and latitudinal differences $a\, \alpha$ and $b\, \alpha$ of the two stars, Put $a\, \alpha = x$, $b\, \alpha = y$, and it will be $x + b\, \beta = aq$, whence $D = \sqrt{\overline{x + \dfrac{m-M}{M\,m} P}\Big| + y\, y}$; and

$$\frac{\sqrt{\overline{D^2 - y^2} \times M^2 m} - x M m}{m - M} = P.$$

If neither of the stars should be in the ecliptic, nor have the same longitude or latitude, the last theorem will still serve to calculate the total parallax whose maximum will lie in E. There will, moreover, arise another parallax, whose maximum will be in the conjunction and opposition, which will be divided, and lie on different sides of the large star; but as we know the whole parallax to be exceedingly small, it will not be necessary to investigate every particular case of this kind; for by reason of the division of the parallax, which renders observations taken at any other times, except where it is greatest, very unfavourable, the formulæ would be of little use. Dr Herschel closes his account of this theory with a general observation on the time and place where the maxima of parallax will happen.

When two unequal stars are both in the ecliptic, or, not being in the ecliptic, have equal latitudes, north or south; and the largest star has most longitude, the maximum of the apparent distance will be when the sun's longitude is 90 degrees more than the stars, or when observed in the morning; and the maximum when the longitude of the sun is 90 degrees less than that of the stars, or when observed in the evening. When the small star has most longitude, the maximum and minimum, as well as the time of observation, will be the reverse of the former. When the stars differ in latitudes, this makes no alteration in the place of the maximum or minimum, nor in the time of observation; i. e. it is immaterial whether the largest star has the least or the greatest distance of the two stars.

400 Different magnitudes of the stars.

The stars, on account of their apparently various magnitudes, have been distributed into several classes, or orders. Those which appear largest are called *stars of the first magnitude;* the next to them in lustre, *stars of the second magnitude;* and so on to the *sixth*, which are the smallest that are visible to the bare eye. This distribution having been made long before the invention of telescopes, the stars which cannot be seen without the assistance of these instruments are distinguished by the name of *telescopic stars*.

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401 Telescopic stars.

The ancients divided the starry sphere into particular constellations, or systems of stars, according as they lay near one another, so as to occupy those spaces which the figures of different sorts of animals or things would take up, if they were there delineated. And those stars which could not be brought into any particular constellation were called *unformed stars*.

402 Unformed stars.

403 Use of their division into constellations.

This division of the stars into different constellations, or asterisms, serves to distinguish them from one another, so that any particular star may be readily found in the heavens by means of a celestial globe; on which the constellations are so delineated as to put the most remarkable stars into such parts of the figures as are most easily distinguished. The number of the ancient constellations is 48, and upon our present globes about 70. On Senex's globes are inserted Bayer's letters; the first in the Greek alphabet being put to the biggest star in each constellation, the second to the next, and so on: by which means, every star is as easily found as if a name were given to it. Thus, if the star γ in the constellation of the ram be mentioned, every astronomer knows as well what star is meant as if it were pointed out to him in the heavens. See fig. 205, 206. where the stars are represented with the figures of the animals from whence the constellations are marked.

404 Division of the heavens. Fig. 26, 29.

There is also a division of the heavens into three parts. 1. The zodiac (ζωδιακος), from ζωδιον *zodion*, "an animal," because most of the constellations in it, which are 12 in number, have the names of animals: As *Aries* the ram, *Taurus* the bull, *Gemini* the twins, *Cancer* the crab, *Libra* the balance, *Scorpio* the scorpion, *Sagittarius* the archer, *Capricornus* the goat, *Aquarius* the water-bearer, and *Pisces* the fishes. The zodiac goes quite round the heavens: it is about 16 degrees broad, so that it takes in the orbits of all the planets, and likewise the orbit of the moon. Along the middle of this zone or belt is the ecliptic, or circle which the earth describes annually as seen from the sun, and which the sun appears to describe as seen from the earth. 2. All that region of the heavens which is on the north side of the zodiac, containing 21 constellations. And, 3. That on the south side, containing 15.

405 Zodiac how divided.

The ancients divided the zodiac into the above 12 constellations or signs in the following manner. They took a vessel with a small hole in the bottom, and, having filled it with water, suffered the same to distil drop by drop into another vessel set beneath to receive it; beginning at the moment when some star rose, and continuing till it rose the next following night. The water falling down into the receiver, they divided into twelve equal parts; and having two other small vessels in readiness, each of them fit to contain one part, they again poured all the water into the upper vessel; and, observing the rising of some star in the zodiac, they at the same time suffered the water to drop into one of the small vessels; and as soon as it was full, they shifted it, and set an empty one in its place. When each vessel was full, they took notice what star of the zodiac rose; and though this could not be done in

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in one night, yet in many they observed the rising of 12 stars or points, by which they divided the zodiac into 12 parts.

The name of the constellations, and the number of stars observed in each of them by different astronomers, are as follow.

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406 Catalogue of the constellations.

The ancient Constellations.		*Ptolemy.*	*Tycho.*	*Hevelius.*	*Flamstead.*
Ursa minor	The Little Bear	8	7	12	24
Ursa major	The Great Bear	35	29	73	87
Draco	The Dragon	31	32	40	80
Cepheus	Cepheus	13	4	51	35
Bootes, *Arctophilax*		23	18	52	54
Corona Borealis	The Northern Crown	8	8	8	21
Hercules, *Engonasin*	Hercules kneeling	29	28	45	113
Lyra	The Harp	10	11	17	21
Cygnus, *Gallina*	The Swan	10	18	47	81
Cassiopeia	The Lady in her Chair	13	26	37	55
Perseus	Perseus	29	29	46	59
Auriga	The Waggoner	14	9	40	66
Serpentarius, *Opiuchus*	Serpentarius	29	15	40	74
Serpens	The Serpent	18	13	22	64
Sagitta	The Arrow	5	5	5	18
Aquila, *Vultur*	The Eagle	15	12	23	71
Antinous	Antinous		3	19	
Delphinus	The Dolphin	10	10	14	18
Equulus, *Equi sectio*	The Horse's Head	4	4	6	10
Pegasus, *Equus*	The Flying Horse	20	19	38	89
Andromeda	Andromeda	23	23	47	66
Triangulum	The Triangle	4	4	12	16
Aries	The Ram	18	21	27	66
Taurus	The Bull	44	43	51	141
Gemini	The Twins	25	25	38	85
Cancer	The Crab	23	15	29	83
Leo	The Lion	35	30	49	95
Coma Berenices	Berenice's Hair		14	21	43
Virgo	The Virgin	32	33	50	110
Libra, *Chelæ*	The Scales	17	10	20	51
Scorpius	The Scorpion	24	10	20	44
Sagittarius	The Archer	31	14	22	69
Capricornus	The Goat	28	28	29	51
Aquarius	The Water-bearer	45	41	47	108
Pisces	The Fishes	38	36	39	113
Cetus	The Whale	22	21	45	97
Orion	Orion	38	42	62	78
Eridanus, *Fluvius*	Eridanus, *the River*	34	10	27	84
Lepus	The Hare	12	13	16	19
Canis major	The Great Dog	29	13	21	31
Canis minor	The Little Dog	2	2	13	14
Argo Navis	The Ship	45	3	4	64
Hydra	The Hydra	27	19	31	60
Crater	The Cup	7	3	10	31
Corvus	The Crow	7	4		9
Centaurus	The Centaur	37			35
Lupus	The Wolf	19			24
Ara	The Altar	7			9
Corona Australis	The Southern Crown	13			12
Pisces Australis	The Southern Fish	18			24

The new Southern Constellations.		
Columba Noachi	Noah's Dove	10
Robur Carolinum	The Royal Oak	12
Grus	The Crane	13
Phœnix	The Phenix	13
Indus	The Indian	12
Pavo	The Peacock	14
Apus, *Avis Indica*	The Bird of Paradise	11
Apis, *Musca*	The Bee or Fly	4
Chamæleon	The Chameleon	10
Triangulum Australis	The South Triangle	5
Piscis volans, *Passer*	The Flying Fish	8
Dorado, *Xiphias*	The Sword Fish	6
Toucan	The American Goose	9
Hydrus	The Water Snake	10

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Hevelius's Constellations made out of the unformed Stars.

		Hevel.	*Flamst.*
Lynx	The Lynx	19	44
Leo minor	The Little Lion		53
Asterion & Chara	The Greyhounds	23	25
Cerberus	Cerberus	4	
Vulpecula & Anser	The Fox and Goose	27	35
Scutum Sobieski	Sobieski's Shield	7	
Larcerta	The Lizard	10	16
Camelopardalus	The Camelopard	32	58
Monocerns	The Unicorn	19	31
Sextans	The Sextant	11	41

407 Change in the obliquity of the ecliptic.

The obliquity of the ecliptic to the equinoctial is found at present to be above the third part of a degree less than Ptolemy found it. And most of the observers after him found it to decrease gradually down to Tycho's time. If it be objected, that we cannot depend on the observations of the ancients, because of the incorrectness of their instruments; we have to answer, that both Tycho and Flamstead are allowed to have been very good observers; and yet we find that Flamstead makes this obliquity 2½ minutes of a degree less than Tycho did about 100 years before him: and as Ptolemy was 1324 years before Tycho, so the gradual decrease answers nearly to the difference of time between these three astronomers. If we consider, that the earth is not a perfect sphere, but an oblate spheroid, having its axis shorter than its equatorial diameter; and that the sun and moon are constantly acting obliquely upon the greater quantity of matter about the equator, pulling it, as it were, towards a nearer and nearer coincidence with the ecliptic; it will not appear improbable that these actions should gradually diminish the angle between those planes. Nor is it less probable that the mutual attractions of all the planets should have a tendency to bring their orbits to a coincidence: but this change is too small to become sensible in many ages.

SECT. IX. *Of calculating the periodical Times, Places, &c. of the Sun, Moon, and Planets: Delineation of the Phases of the Moon for any particular Time; and the Construction of Astronomical Tables.*

THIS title includes almost all of what may be called the *Practical part of Astronomy*; and as it is by far the most difficult and abstruse, so the thorough investigation of it would necessarily lead us into very deep geometrical demonstrations. The great labours of former astronomers have left little for succeeding ones to do in this respect: tables of the motions of all the celestial bodies have been made long ago, the periodical times, eccentricities, &c. of the planets determined; and as we suppose few will desire to repeat these laborious operations, we shall here content ourselves with giving some general hints of the methods by which these things have been originally accomplished, that so the operations of the young astronomer who makes use of tables already formed to his hand may not be merely mechanical.

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It hath been already observed, that the foundation of all astronomical operations was the drawing a meridian line. This being done, the next thing is to find out the latitude of the place where the observations are to be made, and for which the meridian line is drawn. From what hath been said, n° 39. it will easily be understood that the latitude of a place must always be equal to the elevation either of the north or south pole above the horizon; because when we are exactly on the equator, both poles appear on the horizon. There is, however, no star exactly in either of the celestial poles; therefore, to find the altitude of that invisible point called the *Pole of the heavens*, we must chose some star near it which does not set; and having by several observations, according to the directions given n° 377, found its greatest and least altitudes, divide their difference by 2; and half that difference added to the least, or subtracted from the greatest, altitude of the star, gives the exact altitude of the pole or latitude of the place. Thus, suppose the greatest altitude of the star observed is 60° and its least 50°, we then know that the altitude of the place where the observation was made is exactly 55°. 308 Latitude of any place how found.

The latitude being once found, the obliquity of the ecliptic, or the angle made by the sun's annual path with the earth's equator, is easily obtained by the following method. Observe, about the summer solstice, the sun's meridian distance from the zenith, which is easily done by a quadrant with a moveable index furnished with sights; if this distance is subtracted from the latitude of the place, provided the sun is nearer the equator than the place of observation, the remainder will be the obliquity of the ecliptic: But if the place of observation is nearer the equator than the sun at that time, the zenith distance must be added. By this method, the obliquity of the ecliptic hath been determined to be 23° 29′. 409 Obliquity of the ecliptic found.

By the same method the declination of the sun from the equator for any day may be found; and thus a table of his declination for every day in the year might be constructed: thus also the declination of the stars might be found. 410 Sun's declination.

Having the declination of the sun, his right ascension and place in the ecliptic may be geometrically found by the solution of a case in spherical trigonometry. For let EQ represent the celestial equator, *y* the sun, and *y* X the ecliptic; then, in the right-angled spherical triangle EC*y*, we have the side E*y*, equal to the sun's declination: the angle EC*y* is always 23° 29′, being the angle of the ecliptic with the equator; and the angle *y*EC is 90°, or a right angle. From these data we can find the side EC the right ascension; and C*y* the sun's place in the ecliptic, or his distance from the equinoctial point; and thus a table of the sun's place for every day in the year, answerable to his declination, may be formed. 411 His place in the ecliptic how found. Fig. 156.

Having the sun's place in the ecliptic, the right ascension of the stars may be found by the help of it and a good pendulum clock: For which purpose, the motion of the clock must be so adjusted that the hand may run through the 24 hours in the same time that a star leaving the meridian will arrive at it again; which time is somewhat shorter than the natural day, because of the space the sun moves through in the mean time eastward. 412 To find the right ascension of the stars.

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ward. The clock being thus adjusted, when the sun is in the meridian, fix the hand to the point from whence we are to begin to reckon our time; and then observe when the star comes to the meridian, and mark the hour and minute that the hand then shows: The hours and minutes described by the index, turned into degrees and minutes of the equator, will give the difference between the right ascension of the sun and stars; which difference, being added to the right ascension of the sun will give the right ascension of the star. Now, if we know the right ascension of any one star, we may from it find the right ascensions of all the others which we see, by marking the time upon the clock between the arrival of the star whose right ascension we know to the meridian, and another star whose ascension is to be found. This time converted into hours and minutes of the equator, will give the difference of right ascensions; from whence, by addition, we collect the right ascension of the star which was to be found out.

413 Their longitudes and latitudes found.

The right ascension and declination of a star being known, its longitude and latitude, or distance from the first star of Aries, and north or south from the ecliptic, may thence be easily found, from the solution of a case in spherical trigonometry, similar to that already mentioned concerning the sun's place; and the places of the fixed stars being all marked in a catalogue according to their longitudes and latitudes, it may thence be conceived how the longitude and latitude of a planet or a comet may be found for any particular time by comparing its distances from them, and it apparent path may thus be traced; and thus the paths of Mercury and Venus were traced by M. Cassini, though Mr Ferguson made use of an orrery for that purpose.

414 To find the periodical times of the planets.

With regard to the planets, the first thing to be done is to find out their periodical times, which is done by observing when they have no latitude. At that time the planet is in the ecliptic, and consequently in one of its nodes; so that by waiting till it returns to the same node again, and keeping an exact account of the time, the periodical time of its revolution round the sun may be known pretty exactly. By the same observations, from the theory of the earth's motion we can find the position of the line of the nodes; and when once the position of this line is found, the angle of inclination of that planet's orbit to the earth may also be known.

415 Eccentricity of the earth's orbit how determined.

The eccentricity of the earth's orbit may be determined by observing the apparent diameters of the sun at different times: when the sun's diameter is least, the earth is at the greatest distance; and when this diameter is greatest, the earth is at its least distance from him. But as this method must necessarily be precarious, another is recommended by Dr Keil, by observing the velocity of the earth in its orbit, or the apparent velocity of the sun, which is demonstrated to be always reciprocally as the square of the distance.

416 Of the other planets.

The eccentricities of the orbits of the other planets may be likewise found by observing their velocities at different times; for all of them observe the same proportions with regard to the increase or decrease of their velocity that the earth does; only, in this case, care must be taken to observe the real, not the apparent, velocities of the planets, the last depending on the motion of the earth at the same time. Their aphelia, or points of their orbits where they are farthest from the sun, may be known by making several observations of their distances from him, and thus perceiving when these distances cease to increase.

417 To find their places in their orbits.

The position of the aphelion being determined, the planet's distance from it at any time may also be found by observation, which is called its *true* or *coequated* anomaly; but by supposing the motion of the planet to be regular and uniform, tables of that motion may be easily constructed. From thence the planet's mean place in its orbit may be found for any moment of time; and one of these moments being fixed upon as an epocha or beginning of the table, it is easy to understand, that from thence tables of the planet's place in its orbit for any number of years either preceding or consequent to that period may be constructed. These tables are to be constructed according to the meridian of equal time, and not true or apparent time, because of the inequalities of the earth's motion as well as that of the planet, and equations must be made to be added to or subtracted from the mean motion of the planet as occasion requires; which will be readily understood from what we have already mentioned concerning the unequal motion of the earth in its orbit. When all the necessary tables are constructed by this or similar methods, the calculating of the planetary places becomes a mere matter of mechanism, and consists only in the proper additions and subtractions according to the directions always given along with such tables.

418 Inaccuracies from the mutual attraction of the planets.

It must be observed, however, that the accidental interference of the planets with one another by their mutual attractions render it impossible to construct any tables that shall remain equally perfect; and therefore frequent actual observations and corrections of the tables will be necessary. This disturbance, however, is inconsiderable, except in the planets Jupiter and Saturn, and they are in conjunction only once in 800 years.

419 Difficulties with regard to the moon.

What hath been already mentioned with regard to the planets, is also applicable to the moon; but with more difficulty, on account of the greater inequalities of her motions, the cause of which has been already explained. She indeed moves in an ellipse as the rest do, and its eccentricity may be better computed from observing her diameter at different times than that of the earth's orbit; but that eccentricity is not always the same. The reason of this, and indeed of all the other lunar inequalities, is, that the sun has a sensible effect upon her by his attraction, as well as the earth. Consequently, when the earth is at its least distance from the sun, her orbit is dilated, and she moves more slowly; and, on the contrary, when the earth is in its aphelion, her orbit contracts, and she moves more swiftly. The eccentricity is always greatest when the line of the apsides coincides with that of the syzygies, and the earth at its least distance from the sun. When the moon is in her syzygies, i. e. in the line that joins the centres of the earth and sun, which is either in her conjunction or opposition, she moves swifter, *cæteris paribus*, than in the quadratures. According to the different distances of the moon from the syzygies, she changes her motion: from the conjunction to her first quadrature, she moves somewhat slower; but recovers her velocity in the second quarter. In the third quarter she again loses, and in the last again recovers it.

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The apogeon of the moon is alſo irregular; being found to move forward when it coincides with the line of the ſyzygies, and backwards whent it cuts that line at right angles. Nor is this motion in any degree equal: in the conjunction or oppoſition, it goes briſkly forwards, and in the quadratures moves either ſlowly forwards, ſtands ſtill, or goes backward. The motion of the nodes has been already taken notice of: but this motion is not uniform more than the reſt; for when the line of the nodes coincides with that of the ſyzygies, they ſtand ſtill; when their line cuts that at right angles, they go backwards with the velocity, as Sir Iſaac Newton hath ſhown, of 16″ 19‴ 24⁗ an hour.

420 Moves equably on her axis. The only equable motion the moon has, is her revolution on her axis, which ſhe always performs exactly in the ſpace of time in which ſhe moves round the earth. From hence ariſes what is called the *moon's libration*; for as the motion round her axis is equable, and that in her orbit unequal, it follows, that when the moon is in her perigee, where ſhe moves ſwifteſt, that part of her ſurface, which on account of the motion in her orbit would be turned from the earth, is not ſo, by reaſon of the motion on her axis. Thus ſome parts in the limb or margin of the moon ſometimes recede from, and ſometimes approach towards, the centre of the diſk. Yet this equable rotation produces an apparent irregularity; for the axis of the moon not being perpendicular but a little inclined to its orbit, and this axis maintaining its paralleliſm round the earth, it muſt neceſſarily change its ſituation with reſpect to an obſerver on the earth, to whom ſometimes the one and ſometimes the other pole of the moon becomes viſible; whence it appears to have a kind of wavering or vacillatory motion.

421 Lunar irregularities accounted for by Sir Iſaac Newton. From all theſe irregularities it may well be concluded, that the calculation of the moon's place in her orbit is a very difficult matter; and indeed, before Sir Iſaac Newton, aſtronomers in vain laboured to ſubject the lunar irregularities to any rule. By his labours, however, and thoſe of other aſtronomers, theſe difficulties are in a great meaſure overcome; and calculations with regard to this luminary may be made with as great certainty as concerning any other.

422 Her periodical time determined by Copernicus. Her periodical time may be determined from the obſervation of two lunar eclipſes, at as great a diſtance from one another as poſſible; for in the middle of every lunar eclipſe, the moon is exactly in oppoſition to the ſun. Compute the time between theſe two eclipſes or oppoſitions, and divide this by the number of lunations that have intervened, and the quotient will be the ſynodical month, or time the moon takes to paſs from one conjunction to another, or from one oppoſition to another. Compute the ſun's mean motion in the time of the ſynodical month, and add this to the entire circle deſcribed by the moon. Then, As that ſum is to 360°, ſo is the quantity of the ſynodical month to the periodical, or time that the moon takes to move from one point of her orbit to the ſame point again. Thus, Copernicus, in the year 1500, November 6th, at 2 hours 20 minutes, obſerved an eclipſe of the moon at Rome; and Auguſt 1ſt 1523, at 4 hours 25 minutes, another at Cracow: hence the quantity of the ſynodical month is thus determined

	Y.	D.	H.	M.
Obſerv. 2d	1523	237	4	25
Obſerv. 1ſt	1500	310	2	20
Interval of time	22	292	2	5
Add the intercalary days for leap years.		5		
Exact interval	22	297	2	5, or 11991005′.

This interval divided by 282, the number of months elapſed in that time, gives 29 days 12 hours 41 minutes for the length of the ſynodical month. But from the obſervations of two other eclipſes, the ſame author more accurately determined the quantity of the ſynodical month to be 29 degrees 11 hours 45 minutes 3 ſeconds: from whence the mean periodical time of the moon comes to be 27 degrees 7 hours 43 minutes 5 ſeconds, which exactly agrees with the obſervations of later aſtronomers.

The quantity of the periodical month being given, by the Rule of Three, we may find the moon's diurnal and horary motion; and thus may tables of the moon's mean motion be conſtructed; and if from the moon's mean diurnal motion that of the ſun be ſubtracted, the remainder will be the moon's mean diurnal motion from the ſun. 423 Her diurnal and horary motion.

Having the moon's diſtance from the ſun, her phaſes for that time may be eaſily delineated by the following method laid down by Dr Keil. "Let the circle COBP repreſent the diſk of the moon, which is turned towards the earth; and let OP be the line in which the ſemicircle OMP is projected, which ſuppoſe to be cut by the diameter BC, at right angles; and making LP the radius, take LF equal to the coſine of the elongation of the moon from the ſun: And then upon BC, as the great axis, and LF the leſſer axis, deſcribe the ſemi-ellipſe BFC. This ellipſe will cut off from the diſk of the moon the portion BFCP of the illuminated face, which is viſible to us from the earth." 424 Her phaſes delineated. Fig. 30. 31.

Since in the middle of a total eclipſe the moon is exactly in the node, if the ſun's place be found for that time, and ſix ſigns added to it, if the eclipſe is a lunar one the ſun will give the place of the node, or if the eclipſe obſerved is a ſolar one, the place of the node and of the ſun are the ſame. From comparing two eclipſes together, the mean motion of the nodes will thus be found out. The apogee of the moon may be known from her apparent diameter, as already obſerved; and by comparing her place when in the apogee at different times, the motion of the apogee itſelf may alſo be determined. 425 Place of the nodes how found.

Theſe ſhort hints will be ſufficient to give a general knowledge of the methods uſed for the ſolution of ſome of the moſt difficult problems in aſtronomy. As for the proper equations to be added or ſubtracted, in order to find out the true motion and place of the moon, together with the particular methods of conſtructing tables for calculating eclipſes, they are given from Mr Ferguſon, in the following ſection.

SECT. X. *Of Eclipſes: With Tables for their Calculation: the Method of conſtructing them: Rules for Calculation, and Directions for the Delineation of Solar and Lunar Eclipſes.*

EVERY planet and ſatellite is illuminated by the ſun; and caſts a ſhadow towards that point of the heavens which is oppoſite to the ſun. This ſhadow is nothing but a privation of light in the ſpace hid from the ſun by the opaque body that intercepts his rays.

426 Eclipſe defined.

When the ſun's light is ſo intercepted by the moon, that to any place of the earth the ſun appears partly or wholly covered, he is ſaid to *undergo an eclipſe*; though, properly ſpeaking, it is only an eclipſe of that part of the earth where the moon's ſhadow or penumbra falls. When the earth comes between the ſun and moon, the moon falls into the earth's ſhadow; and having no light of her own, ſhe ſuffers a real eclipſe from the interception of the ſun's rays. When the ſun is eclipſed to us, the moon's inhabitants, on the ſide next the earth, ſee her ſhadow like a dark ſpot travelling over the earth, about twice as faſt as its equatorial parts move, and the ſame way as they move. When the moon is in an eclipſe, the ſun appears eclipſed to her, total to all thoſe parts on which the earth's ſhadow falls, and of as long continuance as they are in the ſhadow.

427 Figure of the earth ſpherical.

That the earth is ſpherical (for the hills take off no more from the roundneſs of the earth, than grains of duſt do from the roundneſs of a common globe) is evident from the figure of its ſhadow on the moon; which is always bounded by a circular line, although the earth is inceſſantly turning its different ſides to the moon, and very ſeldom ſhows the ſame ſide to her in different eclipſes, becauſe they ſeldom happen at the ſame hours. Were the earth ſhaped like a round flat plate, its ſhadow would only be circular when either of its ſides directly faced the moon, and more or leſs elliptical as the earth happened to be turned more or leſs obliquely towards the moon when ſhe is eclipſed.

428 Moon's figure the ſame.

The moon's different phaſes prove her to be round; for as ſhe keeps ſtill the ſame ſide towards the earth, if that ſide were flat, as it appears to be, ſhe would never be viſible from the third quarter to the firſt; and from the firſt quarter to the third, ſhe would appear as round as when we ſay *ſhe is full*; becauſe, at the end of her firſt quarter, the ſun's light would come as ſuddenly on all her ſide next the earth, as it does on a flat wall, and go off as abruptly at the end of her third quarter.

429 Shadows of the earth and moon conical.

If the earth and ſun were equally large, the earth's ſhadow would be infinitely extended, and all of the ſame bulk; and the planet Mars, in either of its nodes and oppoſite to the ſun, would be eclipſed in the earth's ſhadow. Were the earth larger than the ſun, its ſhadow would increaſe in bulk the farther it extended, and would eclipſe the great planets Jupiter and Saturn, with all their moons, when they were oppoſite to the ſun. But as Mars, in oppoſition, never falls into the earth's ſhadow, altho' he is not then above 42,000,000 miles from the earth, it is plain that the earth is much leſs than the ſun; for otherwiſe its ſhadow could not end in a point at ſo ſmall a diſtance. If the ſun and moon were equally large, the moon's ſhadow would go on to the earth with an equal breadth, and cover a portion of the earth's ſurface more than 2000 miles broad, even if it fell directly againſt the earth's centre, as ſeen from the moon; and much more if it fell obliquely on the earth: But the moon's ſhadow is ſeldom 150 miles broad at the earth, unleſs when it falls very obliquely on the earth, in total eclipſes of the ſun. In annular eclipſes, the moon's real ſhadow ends in a point at ſome diſtance from the earth. The moon's ſmall diſtance from the earth, and the ſhortneſs of her ſhadow, prove her to be leſs than the ſun. And, as the earth's ſhadow is large enough to cover the moon, if her diameter were three times as large as it is (which is evident from her long continuance in the ſhadow when ſhe goes through its centre), it is plain that the earth is much bigger than the moon.

430 Why there are ſo few eclipſes.

Though all opaque bodies, on which the ſun ſhines, have their ſhadows, yet ſuch is the bulk of the ſun, and the diſtances of the planets, that the primary planets can never eclipſe one another. A primary can eclipſe only its ſecondary, or be eclipſed by it; and never but when in oppoſition or conjunction with the ſun. The primary planets are very ſeldom in theſe poſitions, but the ſun and moon are ſo every month: Whence one may imagine, that theſe two luminaries ſhould be eclipſed every month. But there are few eclipſes in reſpect of the number of new and full moons; the reaſon of which we ſhall now explain.

If the moon's orbit were coincident with the plane of the ecliptic, in which the earth always moves and the ſun appears to move, the moon's ſhadow would fall upon the earth at every change, and eclipſe the ſun to ſome parts of the earth. In like manner, the moon would go through the middle of the earth's ſhadow, and be eclipſed at every full; but with this difference, that ſhe would be totally darkened for above an hour and an half; whereas the ſun never was above four minutes totally eclipſed by the interpoſition of the moon. But one half of the moon's orbit is elevated $5\frac{1}{3}$ degrees above the ecliptic, and the other half as much depreſſed below it; conſequently, the moon's orbit interſects the ecliptic in two oppoſite points called the *moon's nodes*, as has been already taken notice of. When theſe points are in a right line with the centre of the ſun at new or full moon, the ſun, moon, and earth, are all in a right line; and if the moon be then new, her ſhadow falls upon the earth; if full, the earth's ſhadow falls upon her. When the ſun and moon are more than 17 degrees from either of the nodes at the time of conjunction, the moon is then generally too high or too low in her orbit to caſt any part of her ſhadow upon the earth; when the ſun is more than 12 degrees from either of the nodes at the time of full moon, the moon is generally too high or too low in her orbit to go through any part of the earth's ſhadow: and in both theſe caſes there will be no eclipſe. But when the moon is leſs than 17 degrees from either node at the time of conjunction, her ſhadow or penumbra falls more or leſs upon the earth, as ſhe is more or leſs within this limit. And when ſhe is leſs than 12 degrees from either node at the time of oppoſition, ſhe goes through a greater or leſs portion of the earth's ſhadow, as ſhe is more or leſs within this limit. Her orbit contains 360 degrees; of which 17, the limit of ſolar eclipſes on either ſide of the nodes, and 12, the limit of lunar eclipſes, are but ſmall portions: And as the ſun commonly paſſes

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by the nodes but twice in a year, it is no wonder that we have so many new and full moons without eclipses.

To illustrate this (fig. 196.), let ABCD be the ecliptic, RSTU a circle laying in the same plane with the ecliptic, and VXYZ the moon's orbit, all thrown into an oblique view, which gives them an elliptical shape to the eye. One half of the moon's orbit, as VWX, is always below the ecliptic, and the other half XYV above it. The points V and X, where the moon's orbit intersects the circle RSTU, which lies even with the ecliptic, are the moon's nodes; and a right line, as XEV, drawn from one to the other, through the earth's centre, is the line of the nodes, which is carried almost parallel to itself round the sun in a year.

If the moon moved round the earth in the orbit RSTU, which is coincident with the plane of the ecliptic, her shadow would fall upon the earth every time she is in conjunction with the sun, and at every opposition she would go through the earth's shadow. Were this the case, the sun would be eclipsed at every change, and the moon at every full, as already mentioned.

But although the moon's shadow N must fall upon the earth at *a*, when the earth is at E, and the moon in conjunction with the sun at *i*, because she is then very near one of her nodes; and at her opposition *n* she must go through the earth's shadow I, because she is then near the other node; yet, in the time that she goes round the earth to her next change, according to the order of the letters XYVW, the earth advances from E to *e*, according to the order of the letters EFGH; and the line of the nodes VEX, being carried nearly parallel to itself, brings the point *f* of the moon's orbit in conjunction with the sun at that next change: and then the moon being at *f*, is too high above the ecliptic to cast her shadow on the earth: and as the earth is still moving forward, the moon at her next opposition will be at *g*, too far below the ecliptic to go through any part of the earth's shadow; for by that time the point *g* will be at a considerable distance from the earth as seen from the sun.

When the earth comes to F, the moon in conjunction with the sun Z is not at *k* in a plane coincident with the ecliptic, but above it at Y in the highest part of her orbit; and then the point *b* of her shadow O goes far above the earth. (as in fig. 2. which is an edge view of fig. 1.). The moon at her next opposition, is not at *o* (fig. 1.), but at W, where the earth's shadow goes far above her (as in fig. 2.). In both these cases the line of the nodes VEX (fig. 1) is about ninety degrees from the sun, and both luminaries are as far as possible from the limits of the eclipses.

When the earth has gone half round the ecliptic, from E to G, the line of the nodes VGX is nearly, if not exactly, directed towards the sun at Z; and then the new moon *l* casts her shadow P on the earth G; and the full moon *p* goes through the earth's shadow L; which brings on eclipses again, as when the earth was at E.

When the earth comes to H, the new moon falls not at *m* in a plane coincident with the ecliptic CD, but at W in her orbit below it; and then her shadow Q (see fig. 197.) goes far below the earth. At the next full she is not at *q* (fig. 196.), but at Y in her orbit $5\frac{1}{3}$ degrees above *q*, and at her greatest height above the ecliptic CD; being then as far as possible, at any opposition, from the earth's shadow M, as in fig. 197.

So, when the earth is at E and G, the moon is about her nodes at new and full, and in her greatest north and south declination (or latitude as it is generally called) from the ecliptic at her quarters; but when the earth is at F or H, the moon is in her greatest north and south declination from the ecliptic at new and full, and in the nodes about her quarters.

The point X, where the moon's orbit crosses the ecliptic, is called the *ascending node*, because the moon ascends from it above the ecliptic; and the opposite point of intersection V called the *descending node*, because the moon descends from it below the ecliptic. When the moon is at Y in the highest point of her orbit, she is in her greatest north latitude; and when she is at W in the lowest point of her orbit, she is in her greatest south latitude.

431 Appearance of eclipses determined from the motion of the nodes.

If the line of the nodes, like the earth's axis, was carried parallel to itself round the sun, there would be just half a year between the conjunctions of the sun and nodes. But the nodes shift backwards, or contrary to the earth's annual motion, $19\frac{1}{3}$ deg. every year; and therefore the same node comes round the sun 19 days sooner every year than on the year before. Consequently, from the time that the ascending node X (when the earth is at E) passes by the sun as seen from the earth, it is only 173 days (not half a year) till the descending node V passes by him. Therefore in whatever time of the year we have eclipses of the luminaries about either node, we may be sure that in 173 days afterward we shall have eclipses about the other node. And when at any time of the year the line of the nodes is in the situation VGX, at the same time next year it will be in the situation *r*G*s*; the ascending node having gone backward, that is, contrary to the order of signs, from X to *s*, and the descending node from V to *r*; each $19\frac{1}{3}$ deg. At this rate, the nodes shift through all the signs and degrees of the ecliptic in 18 years and 225 days; in which time there would always be a regular period of eclipses, if any complete number of lunations were finished without a fraction. But this never happens; for if both the sun and moon should start from a line of conjunction with either of the nodes in any point of the ecliptic, the sun would perform 18 annual revolutions and 222 degrees over and above, and the moon 230 lunations and 85 degrees of the 231st, by the time the node came round to the same point of the ecliptic again; so that the sun would then be 138 degrees from the node, and the moon 85 degrees from the sun.

But, in 223 mean lunations, after the sun, moon, and nodes, have been once in a line of conjunction, they return so nearly to the same state again, as that the same node, which was in conjunction with the sun and moon at the beginning of the first of these lunations, will be within 28′ 12″ of a degree of a line of conjunction with the sun and moon again, when the last of these lunations is completed. And therefore in that time there will be a regular period of eclipses, or return of the same eclipse, for many ages.——In this period (which was first discovered by the Chaldeans) there are 18 Julian years 11 days 7 hours 43 minutes 20 seconds, when the last day of February in leap years is four times included; but when it is five times included,

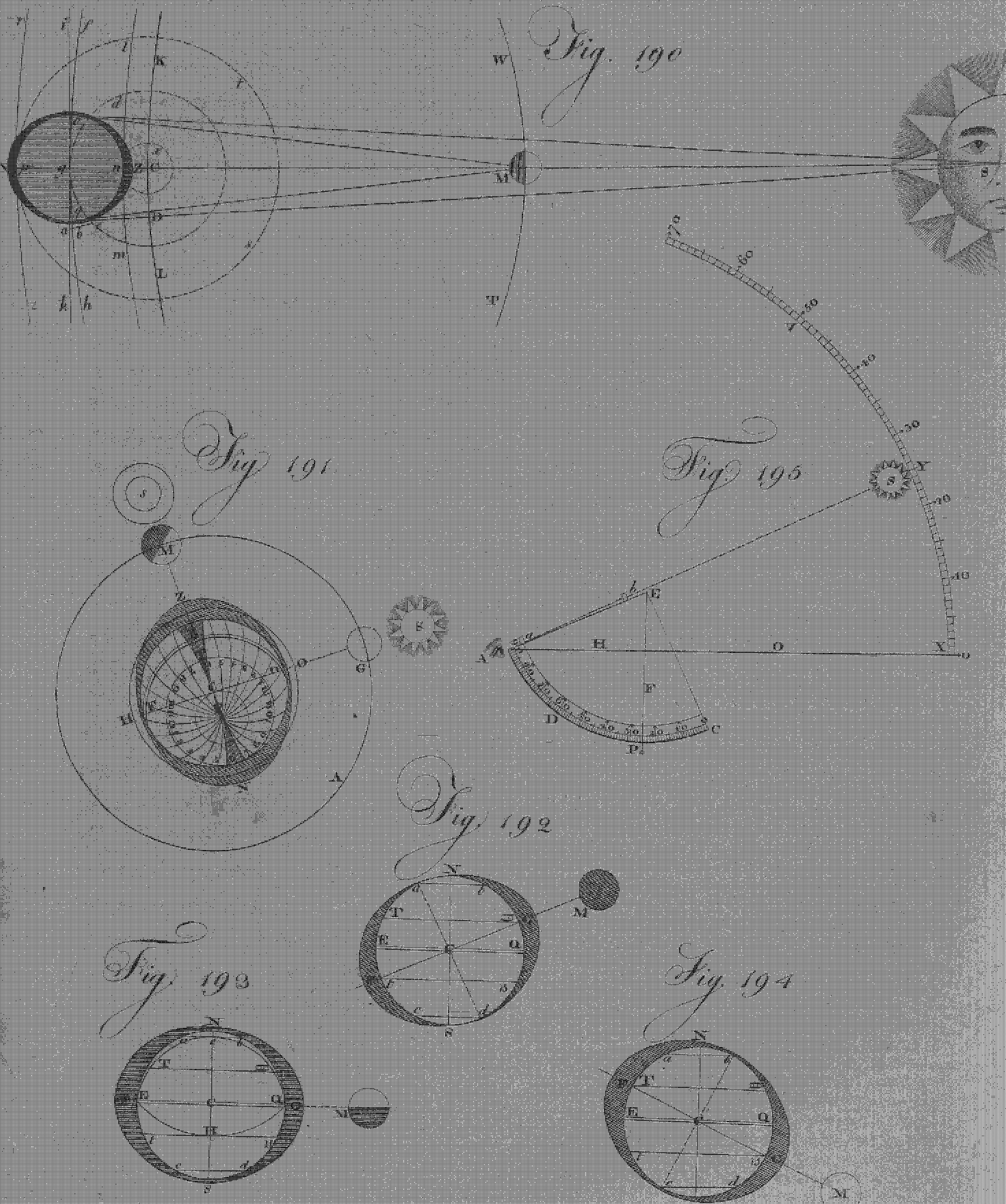

Fig. 190

Fig. 191

Fig. 195

Fig. 192

Fig. 193

Fig. 194

Scot Philad.a

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ded, the period conſiſts of only 18 years 10 days 7 hours 43 minutes 20 ſeconds. Conſequently, if to the mean time of any eclipſe, either of the ſun or moon, you add 18 Julian years 11 days 7 hours 43 minutes 20 ſeconds, when the laſt day of February in leap-years comes in four times, or a day leſs when it comes in five times, you will have the mean time of the return of the ſame eclipſe.

432 When the ſame eclipſe returns again.

But the falling back of the line of conjunctions or oppoſitions of the ſun and moon 28′ 12″ with reſpect to the line of the nodes in every period, will wear it out in proceſs of time; and after that, it will not return again in leſs than 12,492 years.—Theſe eclipſes of the ſun, which happen about the aſcending node, and begin to come in at the north pole of the earth, will go a little ſoutherly at each return, till they go quite off the earth at the ſouth pole; and thoſe which happen about the deſcending node, and begin to come in at the ſouth pole of the earth, will go a little northerly at each return, till at laſt they quite leave the earth at the north pole.

433 Hiſtory of the ſolar eclipſe in 1764.

To exemplify this matter, we ſhall firſt conſider the ſun's eclipſe (March 21ſt old ſtyle, April 1ſt new ſtyle), A. D. 1764, according to its mean revolutions, without equating the times, or the ſun's diſtance from the node; and then according to its true equated times.

This eclipſe fell in open ſpace at each return, quite clear of the earth, ever ſince the creation, till A. D. 1295, June 13th old ſtyle, at 12h. 52m. 59 ſec. *poſt meridiem*, when the moon's ſhadow firſt touched the earth at the north pole; the ſun being then 17° 48′ 27″ from the aſcending node. In each period ſince that time, the ſun has come 28′ 12″ nearer and nearer the ſame node, and the moon's ſhadow has therefore gone more and more ſoutherly.—In the year 1962, July 18th old ſtyle, at 19 h. 36 m. 21 ſec. *p. m.* when the ſame eclipſe will have returned 38 times, the ſun will be only 24′ 45″ from the aſcending node, and the centre of the moon's ſhadow will fall a little northward of the earth's centre.—At the end of the next following period, A. D. 1980, July 28th old ſtyle, at 18 h. 19 m. 41 ſec. *p. m.* the ſun will have receded back 3′ 27″ from the aſcending node, and the moon will have a very ſmall degree of ſouthern latitude, which will cauſe the centre of her ſhadow to paſs a very ſmall matter ſouth of the earth's centre.—After which, in every following period, the ſun will be 28′ 12″ farther back from the aſcending node than in the period laſt before; and the moon's ſhadow will go ſtill farther and farther ſouthward, until September 12th old ſtyle, at 23 h. 46 m. 22 ſec. *p. m.* A. D. 2665; when the eclipſe will have completed its 77th periodical return, and will go quite off the earth at the ſouth pole (the ſun being then 17° 55′ 22″ back from the node), and cannot come in at the north pole, ſo as to begin the ſame courſe over again, in leſs than 12,492 years afterwads.—And ſuch will be the caſe of every other eclipſe of the ſun: For, as there is about 18 degrees on each ſide of the node within which there is a poſſibility of eclipſes, their whole revolution goes through 36 degrees about that node, which, taken from 360 degrees, leaves remaining 324 degrees for the eclipſes to travel *in expanſum*. And as this 36 degrees is not gone through in leſs than 77 periods, which takes up 1388 years, the remaining 324 degrees cannot be ſo gone through in leſs than 12,492 years. For, as 36 is to 1388, ſo is 324 to 12,492.

434 Of the eclipſe in 1748.

To illuſtrate this a little farther, we ſhall examine ſome of the moſt remarkable circumſtances of the returns of the eclipſe which happened July 14th 1748, about noon. This eclipſe, after traverſing the voids of ſpace from the creation, at laſt began to enter the Terra Auſtralis Incognita about 88 years after the conqueſt, which was the laſt of king Stephen's reign: every Chaldean period it has crept more northerly, but was ſtill inviſible in Britain before the year 1622; when, on the 30th of April, it began to touch the ſouth parts of England about two in the afternoon; its central appearance riſing in the American ſouth ſeas, and traverſing Peru and the Amazon's country, through the Atlantic ocean into Africa, and ſetting in the Æthiopian continent, not far from the beginning of the Red ſea.

Its next viſible period was, after three Chaldean revolutions, in 1676, on the firſt of June, riſing central in the Atlantic ocean, paſſing us about nine in the morning, with four digits eclipſed on the under limb, and ſetting in the gulph of Cochinchina in the Eaſt Indies.

It being now near the ſolſtice, this eclipſe was viſible the very next return in 1694, in the evening; and in two periods more, which was in 1730, on the 4th of July, was ſeen about half eclipſed juſt after ſun-riſe, and obſerved both at Wirtemberg in Germany, and Pekin in China, ſoon after which it went off.

Eighteen years more afforded us the eclipſe which fell on the 14th of July 1748.

The next viſible return happened on July 25th 1766 in the evening, about four digits eclipſed; and, after two periods more, will happen on Auguſt 16th 1802, early in the morning, about five digits, the centre coming from the north frozen continent, by the capes of Norway, through Tartary, China, and Japan, to the Ladrone iſlands, where it goes off.

Again, in 1820, Auguſt 26th, between one and two, there will be another great eclipſe at London, about 10 digits; but, happening ſo near the equinox, the centre will leave every part of Britain to the weſt, and enter Germany at Embden, paſſing by Venice, Naples, Grand Cairo, and ſet in the gulf of Baſſora near that city.

It will be no more viſible till 1874, when five digits will be obſcured (the centre being now about to leave the earth) on September 28th. In 1892, the ſun will go down eclipſed in London: and again, in 1928, the paſſage of the centre will be in the *expanſum*, though there will be two digits eclipſed at London, October the 31ſt of that year, and about the year 2090 the whole penumbra will be wore off; whence no more returns of this eclipſe can happen till after a revolution of 10,000 years.

435 Period in which the phenomena of an eclipſe are completed.

From theſe remarks on the entire revolution of this eclipſe, we may gather, that a thouſand years more or leſs (for there are ſome irregularities that may protract or lengthen this period 100 years), complete the whole terreſtrial phenomena of any ſingle eclipſe: and ſince 20 periods of 54 years each, and about 33 days, comprehend the entire extent of their revolution, is is evident, that the times of the returns will paſs through a circuit of one year and ten months, every Chaldean period

being

being 10 or 11 days later, and of the equable appearances, about 32 or 33 days. Thus, though this eclipse happens about the middle of July, no other subsequent eclipse of this period will return till the middle of the same month again; but wear constantly each period 10 or 11 days forward, and at last appear in winter, but then it begins to cease from affecting us.

436 Seldom more than two great eclipses in this period.

Another conclusion from this revolution may be drawn, that there will seldom be any more than two great eclipses of the sun in the interval of this period, and these follow sometimes next return, and often at greater distances. That of 1715 returned again in 1733 very great; but this present eclipse will not be great till the arrival of 1820, which is a revolution of four Chaldean periods: so that the irregularities of their circuits must undergo new computations to assign them exactly.

437 Eclipses come in by the north and south poles.

Nor do all eclipses come in at the south pole: that depends altogether on the position of the lunar nodes, which will bring in as many from the expansum one way as the other; and such eclipses will wear more southerly by degrees, contrary to what happens in the present case.

The eclipse, for example, of 1736 in September, had its centre in the expansum, and set about the middle of its obscurity in Britain; it will wear in at the north pole, and in the year 2600, or thereabouts, go off into the expansum on the south side of the earth.

The eclipses therefore which happened about the creation are little more than half way yet of their etherial circuit; and will be 4000 years before they enter the earth any more. This grand revolution seems to have been entirely unknown to the ancients.

438 Very ancient eclipses cannot be calculated by our tables.

It is particularly to be noted, that eclipses which have happened many centuries ago will not be found by our present tables to agree exactly with ancient observations, by reason of the great anomalies in the lunar motions; which appears an incontestable demonstration of the non-eternity of the universe. For it seems confirmed by undeniable proofs, that the moon now finishes her period in less time than formerly, and will continue, by the centripetal law, to approach nearer and nearer the earth, and to go sooner and sooner round it: nor will the centrifugal power be sufficient to compensate the different gravitations of such an assemblage of bodies as constitute the solar system, which would come to ruin of itself, without some regulation and adjustment of their original motions.

We are credibly informed from the testimony of the ancients, that there was a total eclipse of the sun predicted by Thales to happen in the fourth year of the 48th Olympiad, either at Sardis or Miletus in Asia, where Thales then resided. That year corresponds to the 585th year before Christ; when accordingly there happened a very signal eclipse of the sun, on the 28th of May, answering to the present 10th of that month, central through North America, the south parts of France, Italy, &c. as far as Athens, or the isles in the Ægean sea; which is the farthest that even the Caroline tables carry it; and consequently make it invisible to any part of Asia, in the total character; though there are good reasons to believe that it extended to Babylon, and went down central over that city. We are not however to imagine, that it was set before it passed Sardis and the Asiatic towns, where the predictor lived; because an invisible eclipse could have been of no service to demonstrate his ability in astronomical sciences to his countrymen, as it could give no proof of its reality.

For a further illustration, Thucydides relates, That a solar eclipse happened on a summer's day, in the afternoon, in the first year of the Peloponnesian war, so great, that the stars appeared. Rhodius was victor in the Olympic games the fourth year of the said war, being also the fourth year of the 87th Olympiad, on the 428th year before Christ. So that the eclipse must have happened in the 431st year before Christ; and by computation it appears, that on the third of August there was a signal eclipse which would have passed over Athens, central about six in the evening, but which our present tables bring no farther than the ancient Syrtes on the African coast, above 400 miles from Athens; which, suffering in that case but nine digits, could by no means exhibit the remarkable darkness recited by this historian: the centre therefore seems to have passed Athens about six in the evening, and probably might go down about Jerusalem, or near it, contrary to the construction of the present tables. These things are only mentioned by way of caution to the present astronomers, in recomputing ancient eclipses; and they may examine the eclipse of Nicias, so fatal to the Athenian fleet; that which overthrew the Macedonian army, &c.

439 Number of eclipses in a year.

In any year, the number of eclipses of both luminaries cannot be less than two, nor more than seven; the most usual number is four, and it is very rare to have more than six. For the sun passes by both the nodes but once a-year, unless he passes by one of them in the beginning of the year; and if he does, he will pass by the same node again a little before the year be finished; because, as these points move $19\frac{1}{3}$ degrees backwards every year, the sun will come to either of them 173 days after the other. And when either node is within 17 degrees of the sun at the time of new moon, the sun will be eclipsed. At the subsequent opposition, the moon will be eclipsed in the other node, and come round to the next conjunction again ere the former node be 17 degrees past the sun, and will therefore eclipse him again. When three eclipses fall about either node, the like number generally falls about the opposite; as the sun comes to it in 173 days afterward; and six lunations contain but four days more. Thus, there may be two eclipses of the sun and one of the moon about each of her nodes. But when the moon changes in either of the nodes, she cannot be near enough the other node at the next full to be eclipsed; and in six lunar months afterwards she will change near the other node: in these cases, there can be but two eclipses in a year, and they are both of the sun.

A longer period than the abovementioned, for comparing and examining eclipses which happen at long intervals of time, is 557 years, 21 days, 18 hours, 30 minutes, 11 seconds; in which time there are 6890 mean lunations; and the sun and node meet again so nearly as to be but 11 seconds distant; but then it is not the same eclipse that returns, as in the shorter period abovementioned.

Eclipses

Eclipſes of the ſun are more frequent than of the moon, becauſe the ſun's ecliptic limits are greater than the moon's; yet we have more viſible eclipſes of the moon than of the ſun, becauſe eclipſes of the moon are ſeen from all parts of that hemiſphere of the earth which is next her, and are equally great to each of thoſe parts; but the ſun's eclipſes are viſible only to that ſmall portion of the hemiſphere next him whereon the moon's ſhadow falls.

440 Why more eclipſes of the moon than of the ſun are obſerved.

The moon's orbit being elliptical, and the earth in one of its focuſes, ſhe is once at her leaſt diſtance from the earth, and once at her greateſt, in every lunation.

441 Total and annular eclipſes.

When the moon changes at her leaſt diſtance from the earth, and ſo near the node that her dark ſhadow falls upon the earth, ſhe appears big enough to cover the whole diſk of the ſun from that part on which her ſhadow falls; and the ſun appears totally eclipſed there for ſome minutes: but when the moon changes at her greateſt diſtance from the earth, and ſo near the node that her dark ſhadow is directed towards the earth, her diameter ſubtends a leſs angle than the ſun's; and therefore ſhe cannot hide his whole diſk from any part of the earth, nor does her ſhadow reach it at that time; and to the place over which the point of her ſhadow hangs, the eclipſe is annular, the ſun's edge appearing like a luminous ring all around the body of the moon.

When the change happens within 17 degrees of the node, and the moon at her mean diſtance from the earth, the point of her ſhadow juſt touches the earth, and ſhe eclipſeth the ſun totally to that ſmall ſpot whereon her ſhadow falls; but the darkneſs is not of a moment's continuance.

The moon's apparent diameter, when largeſt, exceeds the ſun's, when leaſt, only 1 minute 38 ſeconds of a degree; and in the greateſt eclipſe of the ſun that can happen at any time and place, the total darkneſs continues no longer than whilſt the moon is going 1 minute 38 ſeconds from the ſun in her orbit, which is about 3 minutes and 13 ſeconds of an hour.

442 Extent of the moon's ſhadow and penumbra.

The moon's dark ſhadow covers only a ſpot on the earth's ſurface about 180 Engliſh miles broad, when the moon's diameter appears largeſt, and the ſun's leaſt; and the total darkneſs can extend no farther than the dark ſhadow covers. Yet the moon's partial ſhadow or penumbra may then cover a circular ſpace 4900 miles in diameter, within all which the ſun is more or leſs eclipſed, as the places are leſs or more diſtant from the centre of the penumbra. When the moon changes exactly in the node, the penumbra is circular on the earth at the middle of the general eclipſe; becauſe at that time it falls perpendicularly on the earth's ſurface; but at every other moment it falls obliquely, and will therefore be elliptical: and the more ſo, as the time is longer before or after the middle of the general eclipſe; and then much greater portions of the earth's ſurface are involved in the penumbra.

443 Beginning, ending, &c. of a ſolar eclipſe.

When the penumbra firſt touches the earth, the general eclipſe begins; when it leaves the earth, the general eclipſe ends: from the beginning to the end the ſun appears eclipſed in ſome part of the earth or other. When the penumbra touches any place, the eclipſe begins at that place, and ends when the penumbra leaves it. When the moon changes in the node, the penumbra goes over the centre of the earth's diſk as ſeen from the moon; and conſequently by deſcribing the longeſt line poſſibly on the earth, continues the longeſt upon it; namely, at a mean rate, 5 hours 50 minutes; more, if the moon be at her greateſt diſtance from the earth, becauſe ſhe then moves ſloweſt; leſs, if ſhe be at her leaſt diſtance, becauſe of her quicker motion.

To make ſeveral of the above and other phenomena plainer, let S be the ſun, E the earth, M the moon, and AMP the moon's orbit. Draw the right line W e from the weſtern ſide of the ſun at W, touching the weſtern ſide of the moon at c, and the earth at e: draw alſo the right line V d from the eaſtern ſide of the ſun at V, touching the eaſtern ſide of the moon at d, and the earth at e: the dark ſpace $c e d$ included between thoſe lines is the moon's ſhadow, ending in a point at e, where it touches the earth; becauſe in this caſe the moon is ſuppoſed to change at M in the middle between A the apogee, or fartheſt point of her orbit from the earth, and P the perigee, or neareſt point to it. For, had the point P been at M, the moon had been nearer the earth; and her dark ſhadow at e would have covered a ſpace upon it about 180 miles broad, and the ſun would have been totally darkened, with ſome continuance: but had the point A been at M, the moon would have been farther from the earth, and her ſhadow would have ended in a point a little above e, and therefore the ſun would have appeared like a luminous ring all around the moon. Draw the right lines WX d b and VX c g, touching the contrary ſides of the ſun and moon, and ending on the earth at a and b: draw alſo the right line SXM, from the centre of the ſun's diſk, through the moon's centre, to the earth; and ſuppoſe the two former lines WXdb and VXcg to revolve on the line SXM as an axis, and their points a and b will deſcribe the limits of the penumbra TT on the earth's ſurface, including the large ſpace $a b a$; within which the ſun appears more or leſs eclipſed, as the places are more or leſs diſtant from the verge of the penumbra $a b$. Fig. 198.

Draw the right line y 12 acroſs the ſun's diſk, perpendicular to SXM the axis of the penumbra: then divide the line y 12 into 12 equal parts, as in the figure, for the twelve digits or equal parts of the ſun's diameter; and, at equal diſtances from the centre of the penumbra at e (on the earth's ſurface at YY) to its edge $a b$, draw twelve concentric circles, marked with the numeral figures 1 2 3 4, &c. and remember that the moon's motion in her orbit AMP is from weſt to eaſt, as from s to t. Then,

To an obſerver on the earth at b, the eaſtern limb of the moon at d ſeems to touch the weſtern limb of the ſun at W, when the moon is at M; and the ſun's eclipſe begins at b, appearing as at A, fig. 203. at the left hand; but at the ſame moment of abſolute time, to an obſerver at a in fig. 198. the weſtern edge of the moon at c leaves the eaſtern edge of the ſun at V, and the eclipſe ends, as at the right hand C fig. 203. At the very ſame inſtant, to all thoſe who live on the circle marked 1 on the earth E, in fig. 198. the moon M cuts off or darkens a twelfth part of the ſun S, and eclipſes him one digit, and at 1 in fig. 203.: to thoſe who live on the circle marked 2 in fig. 198. the moon cuts off two-twelfth parts of the ſun, as at 2 in fig. 203.: to thoſe on the circle 3, three parts; and ſo

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on to the centre at 12 in fig. 198. where the sun is centrally eclipsed, as at B in the middle of fig. 203.; under which figure there is a scale of hours and minutes, to show at a mean state how long it is from the beginning to the end of a central eclipse of the sun on the parallel of London; and how many digits are eclipsed at any particular time from the beginning at A to the middle at B, or the end at C. Thus, in 16 minutes from the beginning, the sun is two digits eclipsed; in an hour and five minutes, eight digits; and in an hour and 37 minutes, 12 digits.

By fig. 198. it is plain, that the sun is totally or centrally eclipsed but to a small part of the earth at any time, because the dark conical shadow *e* of the moon M falls but on a small part of the earth; and that the partial eclipse is confined at that time to the space included by the circle *a b*, of which only one half can be projected in the figure, the other half being supposed to be hid by the convexity of the earth E: and likewise that no part of the sun is eclipsed to the large space YY of the earth, because the moon is not between the sun and any of that part of the earth; and therefore to all that part of the eclipse is invisible. The earth turns eastward on its axis, as from *g* to *h*, which is the same way that the moon's shadow moves; but the moon's motion is much swifter in her orbit from *s* to *t*: and therefore, although eclipses of the sun are of longer duration on account of the earth's motion on its axis than they would be if that motion was stopped, yet, in four minutes of time at most, the moon's swifter motion carries her dark shadow quite over any place that its centre touches at the time of greatest obscuration. The motion of the shadow on the earth's disk is equal to the moon's motion from the sun, which is about 30½ minutes of a degree every hour at a mean rate; but so much of the moon's orbit is equal to 30½ degrees of a great circle on the earth; and therefore the moon's shadow goes 30½ degrees, or 1830 geographical miles, on the earth in an hour, or 30½ miles in a minute, which is almost four times as swift as the motion of a cannon-ball.

As seen from the sun or moon, the earth's axis appears differently inclined every day of the year, on account of keeeping its parallelism throughout its annual course. In fig. 205. let EDON be the earth at the two equinoxes and the two solstices, NS its axis, N the north pole, S the south pole, ÆQ the equator, T the tropic of Cancer, *t* the tropic of Capricorn, and ABC the circumference of the earth's enlightened disk as seen from the sun or new moon at these times. The earth's axis has the position NES at the vernal equinox, lying towards the right hand, as seen from the sun or new moon; its poles N and S being then in the circumference of the disk; and the equator and all its parallels seen to be straight lines, because their planes pass through the observer's eye looking down upon the earth from the sun or moon directly over E, where the ecliptic FG intersects the equator Æ. At the summer solstice, the earth's axis has the position NDS; and that part of the ecliptic FG, in which the moon is then new, touches the tropic of Cancer T at D. The north pole at that time inclining 23½ degrees towards the sun, falls so many degrees within the earth's enlightened disk, because the sun is then vertical to D 23½ degrees north of the equator ÆQ; and the equator with all its parallels seem elliptic curves bending downward, or towards the south pole, as seen from the sun; which pole, together with 23½ degrees all round it, is hid behind the disk in the dark hemisphere of the earth. At the autumnal equinox, the earth's axis has the position NOS, lying to the left hand as seen from the sun or new moon, which are then vertical to O, where the ecliptic cuts the equator ÆQ. Both poles now lie in the circumference of the disk, the north pole just going to disappear behind it, and the south pole just entering into it; and the equator, with all its parallels, seem to be straight lines, because their planes pass through the observer's eye, as seen from the sun, and very nearly so as seen from the moon. At the winter solstice, the earth's axis has the position NNS, when its south pole S inclining 23½ degrees towards the sun, falls 23½ degrees within the enlightened disk, as seen from the sun or new moon, which are then vertical to the tropic of Capricorn *t*, 23½ degrees south of the equator ÆQ; and the equator, with all its parallels, seem elliptic curves bending upward; the north pole being as far behind the disk in the dark hemisphere as the south pole is come into the light. The nearer that at any time of the year is to the equinoxes or solstices, the more it partakes of the phenomena relating to them.

Thus it appears, that from the vernal equinox to the autumnal, the north pole is enlightened; and the equator and all its parallels appear elliptical as seen from the sun, more or less curved as the time is nearer to, or farther from, the summer solstice; and bending downwards, or towards the south pole; the reverse of which happens from the autumnal equinox to the vernal. A little consideration will be sufficient to convince the reader, that the earth's axis inclines towards the sun at the summer solstice; from the sun at the winter solstice: and sidewise to the sun at the equinoxes; but towards the right hand, as seen from the sun at the vernal equinox; and towards the left hand at the autumnal. From the winter to the summer solstice, the earth's axis inclines more or less to the right hand, as seen from the sun; and the contrary from the summer to the winter solstice.

444 Eclipses affected by the position of the earth's axis.

The different positions of the earth's axis, as seen from the sun at different times of the year, affect solar eclipses greatly with regard to particular places; yea, so far as would make central eclipses which fall at one time of the year invisible if they fell at another, even though the moon should always change in the nodes, and at the same hour of the day; of which indefinitely various affections, we shall only give examples for the times of the equinoxes and solstices.

In the same diagram, let FG be part of the ecliptic, and IK, *i k*, *i k*, *i k*, part of the moon's orbit; both seen edgewise, and therefore projected into right lines; and let the intersections NODE be one and the same node at the above times, when the earth has the forementioned different positions; and let the spaces included by the circles P *p p p* be the penumbra at these times, as its centre is passing over the centre of the earth's disk. At the winter solstice, when the earth's axis has the position NNS, the centre of the penumbra P touches the tropic of Capricorn *t* in N at the middle of the general eclipse; but no part of the penumbra touches the tropic of Cancer T. At the sum

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summer solstice, when the earth's axis has the position NDS (*i* D *k* being then part of the moon's orbit whose node is at D), the penumbra *p* has its centre at D, on the tropic of Cancer T, at the middle of the general eclipse, and then no part of it touches the tropic of Capricorn *t*. At the autumnal equinox, the earth's axis has the position NOS (*i* O *k* being then part of the moon's orbit), and the penumbra equally includes part of both tropics T and *t* at the middle of the general eclipse: at the vernal equinox it does the same, because the earth's axis has the position NES; but, in the former of these two last cases, the penumbra enters the earth at A, north of the tropic of Cancer T, and leaves it at *m*, south of the tropic of Capricorn *t*; having gone over the earth obliquely southward, as its centre described the line AO*m*: whereas, in the latter case, the penumbra touches the earth at *n*, south of the equator ÆQ, and describing the line *n*E*q* (similar to the former line AO*m* in open space), goes obliquely northward over the earth, and leaves it at *q*, north of the equator.

In all these circumstances the moon has been supposed to change at noon in her descending node: Had she changed in her ascending node, the phenomena would have been as various the contrary way, with respect to the penumbra's going northward or southward over the earth. But because the moon changes at all hours, as often in one node as in the other, and at all distances from them both at different times as it happens, the variety of the phases of eclipses are almost innumerable, even at the same places; considering also how variously the same places are situated on the enlightened disk of the earth, with respect to the penumbra's motion, at the different hours when eclipses happen.

When the moon changes 17 degrees short of her descending node, the penumbra P 18 just touches the northern part of the earth's disk, near the north pole N; and as seen from that place, the moon appears to touch the sun, but hides no part of him from sight. Had the change been as far short of the ascending node, the penumbra would have touched the southern part of the disk near the south pole S. When the moon changes 12 degrees short of the descending node, more than a third part of the penumbra P12 falls on the northern part of the earth at the middle of the general eclipse: Had she changed as far past the same node, as much of the other side of the penumbra about P would have fallen on the southern part of the earth; all the rest in the expansum, or open space. When the moon changes 6 degrees from the node, almost the whole penumbra P6 falls on the earth at the middle of the general eclipse. And lastly, when the moon changes in the node at N, the penumbra PN takes the longest course possible on the earth's disk; its centre falling on the middle thereof, at the middle of the general eclipse. The farther the moon changes from either node, within 17 degrees of it, the shorter is the penumbra's continuance on the earth, because it goes over a less portion of the disk, as is evident by the figure.

445 Duration of eclipses in different parts of the earth.

The nearer that the penumbra's centre is to the equator at the middle of the general eclipse, the longer is the duration of the eclipse at all those places where it is central; because, the nearer that any place is to the equator, the greater is the circle it describes by the earth's motion on its axis: and so the place moving quicker, keeps longer in the penumbra, whose motion is the same way with that of the place, though faster, as has been already mentioned. Thus (see the earth at D, and the penumbra at 12) whilst the point *b* in the polar circle *a b c d* is carried from *b* to *c* by the earth's diurnal motion, the point *d* on the tropic of Cancer T is carried a much greater length from *d* to D; and therefore, if the penumbra's centre goes one time over *c* and another time over D, the penumbra will be longer in passing over the moving place *d* than it was in passing over the moving place *b*. Consequently, central eclipses about the poles are of the shortest duration; and about the equator, of the longest.

In the middle of summer, the whole frigid zone, included by the polar circle *abcd*, is enlightened; and if it then happens that the penumbra's centre goes over the north pole, the sun will be eclipsed much the same number of digits at *a* as at *c*; but whilst the penumbra moves eastward over *c*, it moves eastward over *a*; because, with respect to the penumbra, the motions of *a* and *c* are contrary: for *c* moves the same way with the penumbra towards *d*, but *a* moves the contrary way towards *b*; and therefore the eclipse will be of longer duration at *c* than at *a*. At *a* the eclipse begins on the sun's eastern limb, but at *c* on his western: at all places lying without the polar circles, the sun's eclipses begin on his western limb, or near it, and end on or near his eastern. At those places where the penumbra touches the earth, the eclipse begins with the rising sun, on the top of his western or uppermost edge; and at those places where the penumbra leaves the earth, the eclipse ends with the setting sun, on the top of his eastern edge, which is then uppermost, just at its disappearing in the horizon.

If the moon were surrounded by an atmosphere of any considerable density, it would seem to touch the sun a little before the moon made her appulse to his edge, and we should see a little faintness on that edge before it were eclipsed by the moon: but as no such faintness has been observed, it seems plain, that the moon has no such atmosphere as that of the earth. The faint ring of light surrounding the sun in total eclipses, called by Cassini *la chevelure du soliel*, is said to be the atmosphere of the sun; because it has been observed to move equally with the sun, not with the moon. See n° 147.

446 Lunar eclipses explained.

Having been so prolix concerning eclipses of the sun, we shall drop that subject at present, and proceed to the doctrine of lunar eclipses; which, being more simple, may be explained in less time.

That the moon can never be eclipsed but at the time of her being full, and the reason why she is not eclipsed at every full, has been shown already. In fig. 198. let S be the sun, E the earth, RR the earth's shadow, and B the moon in opposition to the sun: In this situation the earth intercepts the sun's light in its way to the moon; and when the moon touches the earth's shadow at *v*, she begins to be eclipsed on her eastern limb *x*, and continues eclipsed until her western limb *y* leaves the shadow at *w*: At B she is in the middle of the shadow, and consequently in the middle of the eclipse.

The moon, when totally eclipsed, is not invisible if she

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she be above the horizon and the sky be clear; but appears generally of a dusky colour, like tarnished copper, which some have thought to be the moon's native light. But the true cause of her being visible is the scattered beams of the sun, bent into the earth's shadow by going through the atmosphere; which, being more or less dense near the earth than at considerable heights above it, refracts or bends the sun's rays more inward, the nearer they are passing by the earth's surface, than those rays which go through higher parts of the atmosphere, where it is less dense according to its height, until it be so thin or rare as to lose its refractive power. Let the circle $f\ g\ h\ i$, concentric to the earth, include the atmosphere whose refractive power vanishes at the heights f and i; so that the rays Wfw and Viv go on straight without suffering the least refraction: but all those rays which enter the atmosphere between f and k, and between i and l, on opposite sides of the earth, are gradually more bent inward as they go thro' a greater portion of the atmosphere, until the rays Wk and Vl touching the earth at m and n, are bent so much as to meet at q, a little short of the moon; and therefore the dark shadow of the earth is contained in the space $m\ o\ q\ p\ n$, where none of the sun's rays can enter; all the rest RR, being mixed by the scattered rays which are refracted as above, is in some measure enlightened by them; and some of those rays falling on the moon, give her the colour of tarnished copper, or of iron almost red hot. So that if the earth had no atmosphere, the moon would be as visible in total eclipses as she is when new. If the moon were so near the earth as to go into its dark shadow, suppose about $p\ o$, she would be invisible during her stay in it; but visible before and after in the fainter shadow RR.

447 Why the moon is visible when eclipsed.

When the moon goes thro' the centre of the earth's shadow, she is directly opposite to the sun; yet the moon has been often seen totally eclipsed in the horizon when the sun was also visible in the opposite part of it: for the horizontal refraction being almost 34 minutes of a degree, and the diameter of the sun and moon being each at a mean state but 32 minutes, the refraction causes both luminaries to appear above the horizon when they are really below it.

When the moon is full at 12 degrees from either of her nodes, she just touches the earth's shadow, but enters not into it. In fig. 204. let GH be the ecliptic, ef the moon's orbit where she is 12 degrees from the node at her full; $c\ d$ her orbit where she is 6 degrees from the node, $a\ b$ her orbit where she is full in the node, AB the earth's shadow, and M the moon. When the moon describes the line $e\ f$, she just touches the shadow, but does not enter into it; when she describes the line $c\ d$, she is totally, though not centrally, immersed in the shadow; and when she describes the line $a\ b$, she passes by the node at M in the centre of the shadow, and takes the longest line possible, which is a diameter, through it: and such an eclipse being both total and central is of the longest duration, namely, 3 hours 57 minutes 6 seconds from the beginning to the end, if the moon be at her greatest distance from the earth; and 3 hours 37 minutes 26 seconds, if she be at her least distance. The reason of this difference is, that when the moon is farthest from the earth, she moves slowest; and when nearest to it, quickest.

The moon's diameter, as well as the sun's, is supposed to be divided into 12 equal parts, called *digits*; and so many of these parts as are darkened by the earth's shadow, so many digits is the moon eclipsed. All that the moon is eclipsed above 12 digits, shows how far the shadow of the earth is over the body of the moon, on that edge to which she is nearest at the middle of the eclipse.

448 Lunar eclipses difficultly observed.

It is difficult to observe exactly either the beginning or ending of a lunar eclipse, even with a good telescope, because the earth's shadow is so faint and ill-defined about the edges, that when the moon is either just touching or leaving it, the obscuration of her limb is scarce sensible; and therefore the nicest observers can hardly be certain to four or five seconds of time. But both the beginning and ending of solar eclipses are visibly instantaneous; for the moment that the edge of the moon's disk touches the sun's, his roundness seems a little broke on that part; and the moment she leaves it, he appears perfectly round again.

449 Eclipses useful in determining longitudes, &c.

In astronomy, eclipses of the moon are of a great use for ascertaining the periods of her motions; especially such eclipses as are observed to be alike in all her circumstances, and have long intervals of time between them. In geography, the longitudes of places are found by eclipses: but for this purpose eclipses of the moon are more useful than those of the sun, because they are more frequently visible, and the same lunar eclipse is of equal largeness and duration at all places where it is seen. In chronology, both solar and lunar eclipses serve to determine exactly the time of any past event: for there are so many particulars observable in every eclipse, with respect to its quantity, the places where it is visible (if of the sun), and the time of the day or night, that it is impossible there can be two solar eclipses in the course of many ages which are alike in all circumstances.

450 Darkness of our Saviour's crucifixion supernatural.

From the above explanation of the doctrine of eclipses, it is evident, that the darkness at our Saviour's crucifixion was supernatural. For he suffered on the day on which the passover was eaten by the Jews, on which day it was impossible that the moon's shadow could fall on the earth; for the Jews kept the passover at the time of full moon: nor does the darkness in total eclipses of the sun last above four minutes in any place; whereas the darkness at the crucifixion lasted three hours, Math. xxviii. 15. and overspread at least all the land of Judea.

451 Construction of tables for calculating eclipses.

The theory of eclipses being now, we hope, pretty plainly laid down, the construction of tables for their calculation will be understood from the following considerations.

The motions of the sun and moon are observed to be continually accelerated from the apogee to the perigee, and as gradually retarded from the perigee to the apogee; being slowest of all when the mean anomaly is nothing, and swiftest of all when it is six signs.

When the luminary is in its apogee or perigee, its place is the same as it would be if its motion were equable in all parts of its orbit. The supposed equable motions are called *mean*; the unequable are justly called the *true*.

The mean place of the sun or moon is always forwarder than the true place, whilst the luminary is moving from its apogee to its perigee: and the true

place

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place is always forwarder than the mean, whilst the luminary is moving from its perigee to its apogee. In the former case the anomaly is always less than six signs; and in the latter case, more.

It has been found by a long series of observations, that the sun goes through the ecliptic, from the vernal equinox to the same equinox again, in 365 days, 5 hours 48 minutes 55 seconds; from the first star of Aries to the same star again, in 365 days 6 hours 9 minutes 24 seconds; and from his apogee to the same again, in 365 days 6 hours 14 minutes 0 seconds.—The first of these is called the *solar year*; the second the *sidereal year*; and the third the *anomalistic year*. So that the solar year is 20 minutes 29 seconds shorter than the sidereal; and the sidereal year is 4 minutes 36 seconds shorter than the anomalistic. Hence it appears, that the equinoctial point, or intersection of the ecliptic and equator at the beginning of Aries, goes backward with respect to the fixed stars, and that the sun's apogee goes forward.

It is also observed that the moon goes through her orbit, from any given fixed star to the same star again, in 27 days 7 hours 43 minutes 4 seconds at a mean rate; and from her apogee to her apogee again, in 27 days 13 hours 18 minutes 43 seconds; and from the sun to the sun again, in 29 days 12 hours 44 minutes $3\frac{1}{10}$ seconds. This shows that the moon's apogee moves forward in the ecliptic, and that at a much quicker rate than the sun's apogee does: since the moon is 5 hours 55 minutes 39 seconds longer in revolving from her apogee to her apogee again, than from any star to the same star again.

The moon's orbit crosses the ecliptic in two opposite points, which are called her *Nodes*: and it is observed, that she revolves sooner from any node to the node again, than from any star to the star again, by 2 hours 38 minutes 27 seconds; which shows that her nodes move backward, or contrary to the order of signs in the ecliptic.

The time in which the moon revolves from the sun to the sun again (or from change to change) is called the *Lunation*; which according to Dr Pound's mean measures, would always consist of 29 days 12 hours 44 minutes 3 seconds 2 thirds 58 fourths, if the motions of the sun and moon were always equable. Hence 12 mean lunations contain 354 days 8 hours 48 minutes 36 seconds 35 thirds 40 fourths, which is 10 days 21 hours 11 minutes 23 seconds 24 thirds 20 fourths less than the length of a common Julian year, consisting of 365 days 6 hours; and 13 mean lunations contain 383 days 21 hours 32 minutes 39 seconds 38 thirds 38 fourths, which exceeds the length of a common Julian year, by 18 days 15 hours 32 minutes 39 seconds 38 thirds 38 fourths.

The mean time of new moon being found for any given year and month, as suppose for March 1700, old style, if this mean new moon falls later than the 11th day of March, then 12 mean lunations added to the time of this mean new moon will give the time of the mean new moon in March 1701, after having thrown off 365 days. But when the mean new moon happens to be before the 11th of March, we must add 13 mean lunations, in order to have the time of mean new moon in March the year following; always taking care to subtract 365 days in common years, and 366 days in leap years, from the sum of this addition.

Thus A. D. 1700, old style, the time of mean new moon in March was the 8th day, at 16 hours 11 minutes 25 seconds after the noon of that day (viz. at 11 minutes 25 seconds past four in the morning of the 9th day, according to common reckoning. To this we must add 13 mean lunations, or 383 days 21 hours 32 minutes 39 seconds 38 thirds 38 fourths, and the sum will be 392 days 13 hours 44 minutes 4 seconds 38 thirds 38 fourths: from which subtract 365 days, because the year 1701 is a common year, and there will remain 27 days 13 hours 44 minutes 4 seconds 38 thirds 38 fourths for the time of a mean new moon in March, A. D. 1701.

Carrying on this addition and subtraction till A. D. 1703, we find the time of mean new moon in March that year to be on the 6th day, at 7 hours 21 minutes 17 seconds 49 thirds 46 fourths past noon; to which add 13 mean lunations, and the sum will be 390 days 4 hours 53 minutes 57 seconds 28 thirds 20 fourths; from which subtract 366 days, because the year 1704 is a leap year, and there will remain 24 days 4 hours 53 minutes 57 seconds 28 thirds 20 fourths, for the time of mean new moon in March, A. D. 1704.

In this manner was the first of the following tables constructed to seconds, thirds, and fourths; and then wrote out to the nearest seconds. The reason why we chose to begin the year with March, was to avoid the inconvenience of adding a day to the tabular time in leap-years after February, or subtracting a day therefrom in January and February in those years; to which all tables of this kind are subject, which begin the year with January, in calculating the times of new or full moons.

The mean anomalies of the sun and moon, and the sun's mean motion from the ascending node of the moon's orbit, are set down in Table III. from 1 to 13 mean lunations. These numbers, for 13 lunations, being added to the radical anomalies of the sun and moon, and to the sun's mean distance from the ascending node, at the time of mean new moon in March 1700 (Table I.), will give their mean anomalies, and the sun's mean distance from the node, at the time of mean new moon in March 1701; and being added for 12 lunations to those for 1701, give them for the time of mean new moon in March 1702. And so on as far as you please to continue the table (which is here carried on to the year 1800), always throwing off 12 signs when their sum exceeds 12, and setting down the remainder as the proper quantity.

If the numbers belonging to A. D. 1700 (in Table I.) be subtracted from those belonging to 1800, we shall have their whole differences in 100 complete Julian years; which accordingly we find to be 4 days 8 hours 10 minutes 52 seconds 15 thirds 40 fourths, with respect to the time of mean new moon. These being added together 60 times (always taking care to throw off a whole lunation when the days exceed $29\frac{1}{2}$) make up 60 centuries, or 6000 years, as in Table VI. which was carried on to seconds, thirds, and fourths; and then wrote out to the nearest seconds. In the same manner were the respective anomalies and the sun's distance from the node found, for these centurial

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turial years; and then (for want of room) wrote out only to the nearest minutes, which is sufficient in whole centuries. By means of these two tables, we may find the time of any mean new moon in March, together with the anomalies of the sun and moon, and the sun's distance from the node, at these times within the limits of 6000 years, either before or after any given year in the 18th century; and the mean time of any new or full moon in any given month after March, by means of the third and fourth tables, within the same limits, as shown in the precepts for calculation.

Thus it would be a very easy matter to calculate the time of any new or full moon, if the sun and moon moved equably in all parts of their orbits. But we have already shown, that their places are never the same as they would be by equable motions, except when they are in apogee or perigee; which is, when their mean anomalies are either nothing, or six signs: and that their mean places are always forwarder than their true places, whilst the anomaly is less than six signs; and their true places are forwarder than the mean, whilst the anomaly is more.

Hence it is evident, that while the sun's anomaly is less than six signs, the moon will overtake him, or be opposite to him, sooner than she could if his motion were equable; and later whilst his anomaly is more than six signs. The greatest difference that can possibly happen between the mean and true time of new or full moon, on account of the inequality of the sun's motion, is 3 hours 48 minutes 28 seconds: and that is, when the sun's anomaly is either 3 signs 1 degree, or 8 signs 29 degrees; sooner in the first case, and later in the last.—In all other signs and degrees of anomaly, the difference is gradually less, and vanishes when the anomaly is either nothing or six signs.

The sun is in his apogee on the 30th of June, and in his perigee on the 30th of December, in the present age: so that he is nearer the earth in our winter than in our summer.—The proportional difference of distance, deduced from the difference of the sun's apparent diameter at these times, is as 983 to 1017.

The moon's orbit is dilated in winter, and contracted in summer; therefore the lunations are longer in winter than in summer. The greatest difference is found to be 22 minutes 29 seconds; the lunations increasing gradually in length whilst the sun is moving from his apogee to his perigee, and decreasing in length whilst he is moving from his perigee to his apogee.—On this account, the moon will be later every time in coming to her conjunction with the sun, or being in opposition to him, from December till June, and sooner from June till December, than if her orbit had continued of the same size all the year round.

As both these differences depend on the sun's anomaly, they may be fitly put together into one table, and called *The annual or first equation of the mean to the true syzygy*, (see Table VII.) This equational difference is to be subtracted from the time of the mean syzygy when the sun's anomaly is less than six signs, and added when the anomaly is more.—At the greatest it is 4 hours 10 minutes 57 seconds, viz. 3 hours 48 minutes 28 seconds, on account of the sun's unequal motion, and 22 minutes 29 seconds, on account of the dilatation of the moon's orbit.

This compound equation would be sufficient for reducing the mean time of new or full moon to the true time thereof, if the moon's orbit were of a circular form, and her motion quite equable in it. But the moon's orbit is more elliptical than the sun's, and her motion in it so much the more unequal. The difference is so great, that she is sometimes in conjunction with the sun, or in opposition to him, sooner by 9 hours 47 minutes 54 seconds, than she would be if her motion were equable; and at other times as much later. The former happens when her mean anomaly is 9 signs 4 degrees, and the latter when it is 2 signs 26 degrees. See Table IX.

At different distances of the sun from the moon's apogee, the figure of the moon's orbit becomes different. It is longest of all, or most eccentric, when the sun is in the same sign and degree either with the moon's apogee or perigee; shortest of all, or least eccentric, when the sun's distance from the moon's apogee is either three signs or nine signs; and at a mean state when the distance is either 1 sign 15 degrees, 4 signs 15 degrees, 7 signs 15 degrees, or 10 signs 15 degrees. When the moon's orbit is at its greatest eccentricity, her apogeal distance from the earth's centre is to her perigeal distance therefrom, as 1067 is to 933; when least eccentric, as 1043 is to 957; and when at the mean state, as 1055 is to 945.

But the sun's distance from the moon's apogee is equal to the quantity of the moon's mean anomaly at the time of new moon, and by the addition of six signs it becomes equal in quantity to the moon's mean anomaly at the time of full moon. Therefore, a table may be constructed so as to answer to all the various inequalities depending on the different eccentricities of the moon's orbit, in the syzygies, and called *The second equation of the mean to the true syzygy*. (See Table IX.): and the moon's anomaly, when equated by Table VIII. may be made the proper argument for taking out this second equation of time; which must be added to the former equated time, when the moon's anomaly is less than six signs, and subtracted when the anomaly is more.

There are several other inequalities in the moon's motion, which sometimes bring on the true syzygy a little sooner, and at other times keep it back a little later, than it would otherwise be: but they are so small, that they may be all omitted except two; the former of which (see Table X.) depends on the difference between the anomalies of the sun and moon in the syzygies, and the latter (see Table XI.) depends on the sun's distance from the moon's nodes at these times.—The greatest difference arising from the former is 4 minutes 48 seconds; and from the latter, 1 minute 34 seconds.

452 Directions for the use of those tables.

The tables here inserted being calculated by Mr Fergusson according to the methods already given, he gives the following directions for their use.

To calculate the true Time of New or full Moon.

Precept I. If the required time be within the limits of the 18th century, write out the mean time of new moon in March, for the proposed year, from Table I. in the old style, or from Table II. in the new; together with the mean anomalies of the sun and moon, and the sun's mean distance from the moon's ascending node. If you want the time of full moon in March, add the half lunation at the foot of Table III. with its

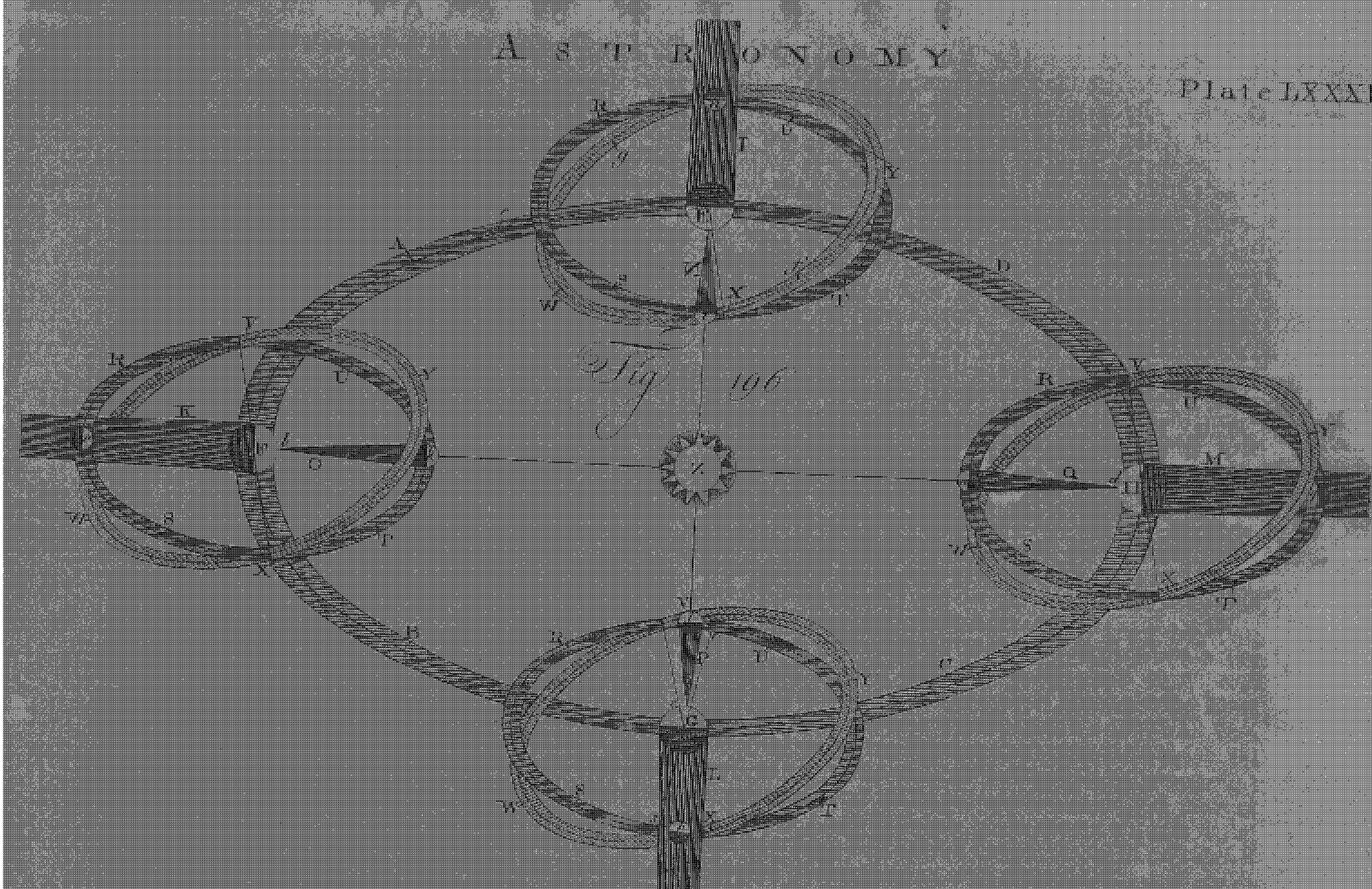


Fig. 196

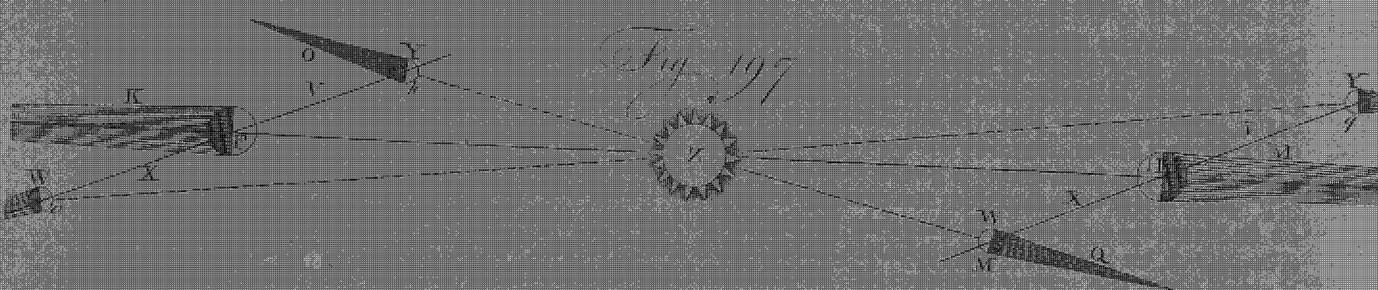
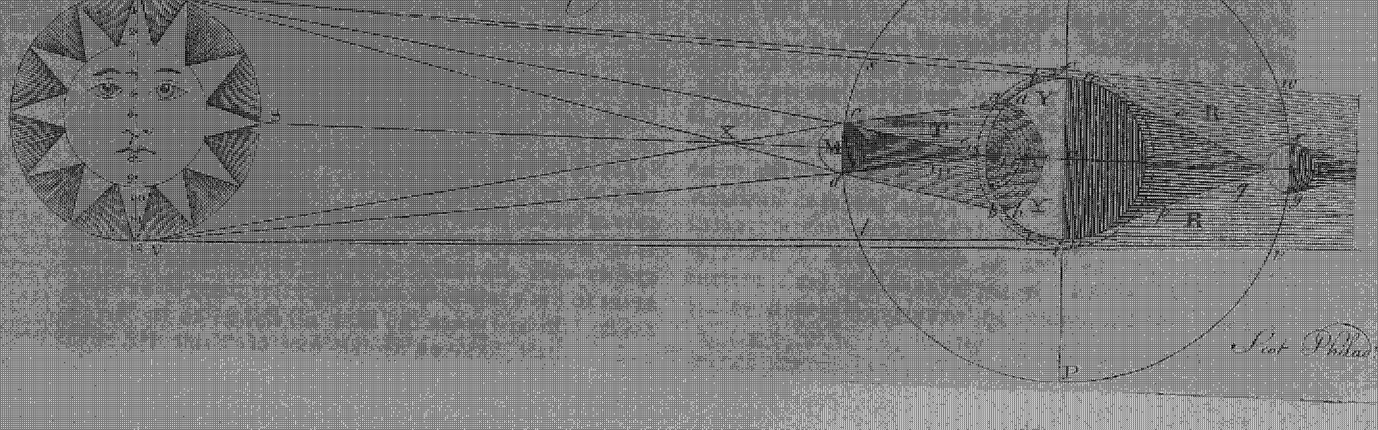


Fig. 197

Fig. 198



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its anomalies, &c. to the former numbers, if the new moon falls before the 15th of March; but if it falls after, subtract the half lunation, with the anomalies, &c. belonging to it, from the former numbers, and write down the respective sums or remainders.

II. In these additions or subtractions, observe, that 60 seconds make a minute, 60 minutes make a degree, 30 degrees make a sign, and 12 signs make a circle. When you exceed 12 signs in addition, reject 12, and set down the remainder. When the number of signs to be subtracted is greater than the number you subtract from, add 12 signs to the lesser number, and then you will have a remainder to set down. In the tables signs are marked thus ^{s}, degrees thus $^\circ$, minutes thus $'$, and seconds thus $''$.

III. When the required new or full moon is in any given month after March, write out as many lunations with their anomalies, and the sun's distance from the node from Table III. as the given month is after March, setting them in order below the numbers taken out for March.

IV. Add all these together, and they will give the mean time of the required new or full moon, with the mean anomalies and sun's mean distance from the ascending node, which are the arguments for finding the proper equations.

V. With the number of days added together, enter Table IV. under the given month; and against that number you have the day of mean new or full moon in the left-hand column, which set before the hours, minutes, and seconds, already found.

But (as it will sometimes happen) if the said number of days fall short of any in the column under the given month, add one lunation and its anomalies, &c. (from Table III.) to the foresaid sums, and then you will have a new sum of days wherewith to enter Table IV. under the given month, where you are sure to find it the second time, if the first falls short.

VI. With the signs and degrees of the sun's anomaly, enter Table VII. and therewith take out the annual or first equation for reducing the mean syzygy to the true; taking care to make proportions in the table for the odd minutes and seconds of anomaly, as the table gives the equation only to whole degrees.

Observe, in this and every other case of finding equations, that if the signs are at the head of the table, their degrees are at the left hand, and are reckoned downwards; but if the signs are at the foot of the table, their degrees are at the right hand, and are counted upward; the equation being in the body of the table, under or over the signs, in a collateral line with the degrees. The titles *Add* or *Subtract* at the head or foot of the tables where the signs are found, show whether the equation is to be added to the mean time of new or full moon, or to be subtracted from it. In this table the equation is to be subtracted, if the signs of the sun's anomaly are found at the head of the table; but it is to be added, if the signs are at the foot.

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VII. With the signs and degrees of the sun's mean anomaly, enter Table VIII. and take out the equation of the moon's mean anomaly; subtract this equation from her mean anomaly, if the signs of the sun's anomaly be at the head of the table, but add it if they are at the foot; the result will be the moon's equated anomaly, with which enter table IX. and take out the second equation for reducing the mean to the true time of new or full moon; adding this equation, if the signs of the moon's anomaly are at the head of the table, but subtracting it if they are at the foot; and the result will give you the mean time of the required new or full moon twice equated, which will be sufficiently near for common almanacs.—But when you want to calculate an eclipse, the following equations must be used: thus,

VIII. Subtract the moon's equated anomaly from the sun's mean anomaly, and with the remainder in signs and degrees enter Table X. and take out the third equation, applying it to the former equated time, as the titles *Add* or *Subtract* do direct.

IX. With the sun's mean distance from the ascending node enter Table XI. and take out the equation answering to that argument, adding it to, or subtracting it from, the former equated time, as the titles direct, and the result will give the time of new or full moon, agreeing with well regulated clocks or watches very near the truth. But to make it agree with the solar, or apparent time, you must apply the equation of natural days, taken from an equation-table, as it is leap-year, or the first, second, or third after. This, however, unless in very nice calculations, needs not be regarded, as the difference between true and apparent time is never very considerable.

The method of calculating the time of any new or full moon without the limits of the 18th century, will be shown further on. And a few examples compared with the precepts will make the whole work plain.

N. B. The tables begin the day at noon, and reckon forward from thence to the noon following.—Thus, March the 31st, at 22 ho. 30 min. 25 sec. of tabular time, is April 1st (in common reckoning) at 30 min. 25 sec. after 10 o'clock in the morning.

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EXAMPLE I.

Required the true time of New Moon in April 1764, *New Style?*

By the Precepts.	New Moon.				Sun's Anomaly.				Moon's Anomaly.				Sun from Node.			
	D.	H.	M.	S.	s	°	'	"	s	°	'	"	s	°	'	"
March 1764,	2	8	55	36	8	2	20	0	10	13	35	21	11	4	54	48
Add 1 Lunation,	29	12	44	3	0	29	6	19	0	25	49	0	1	0	40	14
Mean New Moon,	31	21	39	39	9	1	26	19	11	9	24	21	0	5	35	2
First Equation,	+	4	10	40	11	10	59	18	+	1	34	57				
Time once equated,	32	1	50	19	9	20	27	1	11	10	59	18	Sun from Node, and Arg. 4th equation.			
Second Equation,	—	3	24	49	Arg. 3d. equation				Arg. 2d equation.							
Time twice equated,	31	22	25	30												
Third Equation,		+	4	37												
Time thrice equated,	31	22	30	7												
Fourth Equation,			+	18												
True New Moon,	31	22	30	25												
Equation of days,		—	3	48												
Apparent time,	31	22	26	37												

So the true time is 22 h. 30 min. 25 sec. after the noon of the 31st March; that is, April 1st, at 30 min. 25 sec. after ten in the morning. But the apparent time is 26 min. 37 sec. after ten in the morning.

EXAMPLE II.

454 Qu. *The true time of the Full Moon in* May 1762, *New Style?*

By the Precepts,	New Moon.				Sun's Anomaly.				Moon's Anomaly.				Sun from Node.			
	D.	H.	M.	S.	s	°	'	"	s	°	'	"	s	°	'	"
March 1762,	24	15	18	24	8	23	48	16	1	23	59	11	10	18	49	14
Add 2 Lunations,	59	1	28	6	1	28	12	39	1	21	38	1	2	1	20	28
New Moon, May,	22	16	46	30	10	22	0	55	3	15	37	12	0	20	9	42
Subt. ½ Lunation,	14	18	22	2	0	14	33	10	6	12	54	30	0	15	20	7
Full Moon, May,	7	22	24	28	10	7	27	45	9	2	42	42	0	4	49	35
First equation,	+	3	16	36	9	3	57	18	+	1	14	36				
Time once equated,	8	1	41	4	1	3	30	27	9	3	57	18	Sun from Node, and Arg. fourth equation.			
Second Equation,	—	9	47	53	Arg. 3d equation.				Arg. 2d equation.							
Time twice equated,	7	15	53	11												
Third Equation,		—	2	36												
Time thrice equated,	7	15	50	35												
Fourth Equation,			+	15												
The Full Moon,	7	15	50	50												

Ans. May 7th at 15 h. 50 min. 50 sec. past noon, *viz.* May 8th at 3 h. 50 min. 50 sec. in the morning.

455 *To calculate the time of New and Full Moon in a given year and month of any particular century, between the Christian æra and the 18th century.*

Precept I. Find a year of the same number in the 18th century with that of the year in the century proposed, and take out the mean time of new moon in March, old style, for that year, with the mean anomalies and sun's mean distance from the node at that time, as already taught.

II. Take as many complete centuries of years from Table VI. as, when subtracted from the abovesaid year in the 18th century, will answer to the given year; and take out the first mean new moon and its anomalies, &c. belonging to the said centuries, and set them below those taken out for March in the 18th century.

III. Subtract the numbers belonging to these centuries from those of the 18th century, and the remainders will be the mean time and anomalies, &c. of new moon, in March, in the given year of the century proposed,—Then, work in all respects for the true time of new or full moon, as shown in the above precepts and examples.

IV. If the days annexed to these centuries exceed the number of days from the beginning of March taken out in the 18th century, add a lunation and its anomalies, &c. from Table III. to the time and anomalies of new moon in March, and then proceed in all respects as above.—This circumstance happens in Example V.

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EXAMPLE III.

Required the true time of Full Moon, in April, Old Style, A. D. 30?

From 1730 subtract 1700 (or 17 centuries) and there remains 30.

By the Precepts.	New Moon.				Sun's Anomaly.				Moon's Anomaly.				Sun from Node.			
	D.	H.	M.	S.	s.	o.	'	''	s.	o.	'	''	s.	o.	'	''
March 1730,	7	12	34	16	8	18	4	31	9	0	32	17	1	23	17	16
Add ½ Lunation,	14	18	22	2	0	14	33	10	6	12	54	30	0	15	20	7
Full Moon,	22	6	56	18	9	2	37	41	3	13	26	47	2	8	37	23
1700 years subtr.	14	17	36	42	11	28	46	0	10	29	36	0	4	29	23	0
Full ☽ March A. D. 30.	7	13	19	36	9	3	51	41	4	13	50	47	9	9	14	23
Add 1 Lunation,	29	12	44	3	0	29	6	19	0	25	49	0	1	0	40	14
Full Moon, April,	6	2	3	39	10	2	58	0	5	9	39	47	10	9	54	37
First Equation,	+	3	28	4	5	10	58	40	+	1	18	53	Sun from Node, and Arg. fourth equation.			
Time once equated,	6	5	31	43	4	21	59	20	5	10	58	40				
Second Equation,	+	2	57	48	Arg. 3d equation.				Arg. 2d equation.							
Time twice equated,	6	8	29	31												
Third Equation,		—	2	54												
Time thrice equated,	6	8	26	37												
Fourth Equation,		—	1	33												
True Full Moon, April,	6	8	25	4												

Hence it appears, that the true time of Full Moon in April, A. D. 30, old style, was on the 6th day at 25 m. 4 s. past eight in the evening.

456 *To calculate the true time of New or Full Moon in any given year and month before the Christian æra.*

Precept I. Find a year in the 18th century, which being added to the given number of years before Christ diminished by one, shall make a number of complete centuries.

II. Find this number of centuries in Table VI. and subtract the time and anomalies belonging to it from those of the mean new moon in March, the above-found year of the 18th century; and the remainder will denote the time and anomalies, &c. of mean new moon in March, the given year before Christ.—Then, for the true time thereof in any month of that year, proceed as above taught.

EXAMPLE IV.

Required the true time of New Moon in May, *Old Style, the year before Christ* 585?

The years 584 added to 1716, makes 2300, or 23 centuries.

By the Precepts.	New Moon.				Sun's Anomaly.				Moon's Anomaly.				Sun from Node.			
	D.	H.	M.	S.	s.	o	'	''	s.	o	'	''	s.	o	'	''
March 1716,	11	17	33	29	8	22	50	39	4	4	14	2	4	27	17	5
2300 years subtract,	11	5	57	53	11	19	47	0	1	5	59	0	7	25	27	0
March before Christ 585,	0	11	35	36	9	3	3	39	2	28	15	2	9	1	50	5
Add 3 Lunations,	88	14	12	9	2	27	18	58	2	17	27	1	3	2	0	42
May before Christ 585,	28	1	47	45	0	0	22	37	5	15	42	3	0	3	50	47
First Equation,		—	1	37	5	15	41	17			—	46	Sun from Node, and Arg. fourth equation.			
Time once equated,	28	1	46	8	6	14	41	20	5	15	41	17				
Second Equation,	+	2	15	1	Arg. 3d equation.				Arg. 2d equation.							
Time twice equated,	28	4	1	9												
Third Equation,		+	1	9												
Time thrice equated,	28	4	2	18												
Fourth Equation,			+	12												
True New Moon,	28	4	2	30												

So the true time was May 28th, at 2 minutes 30 seconds past four in the afternoon.

These Tables are calculated for the meridian of London; but they will serve for any other place, by subtracting four minutes from the tabular time, for every degree that the meridian of the given place is westward of London, or adding four minutes for every degree that the meridian of the given place is eastward: as in

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EXAMPLE V.

Required the true time of Full Moon at Alexandria *in* Egypt *in* September, *Old Style, the year before Christ* 201?
The years 200 added to 1800, make 2000, or 20 centuries.

By the Precepts.	New Moon.				Sun's Anomaly.				Moon's Anomaly.				Sun from Node.			
	D.	H.	M.	S.	s	°	′	″	s	°	′	″	s	°	′	″
March 1800,	13	0	22	17	8	23	19	55	10	7	52	36	11	3	58	24
Add 1 Lunation,	29	12	44	3	0	29	6	19	0	25	49	0	1	0	40	14
From the sum,	42	13	6	20	9	22	26	14	11	3	41	36	0	4	38	38
Subtract 2000 years,	27	18	9	19	0	8	50	0	0	15	42	0	6	27	45	0
N. M. bef. Chr. 201,	14	18	57	1	9	13	36	14	10	17	59	36	5	6	53	38
Add { 6 Lunations,	177	4	24	18	5	24	37	56	5	4	54	3	6	4	1	24
{ half Lunations,	14	18	22	2	0	14	33	10	6	12	54	30	0	15	20	7
Full Moon, September,	22	17	43	21	3	22	47	20	10	5	48	9	11	26	15	9
First Equation,	—	3	52	6	10	4	19	55	—	1	28	14	Sun from Node, and Argument fourth equation.			
Time once equated,	22	13	51	15	5	18	27	25	10	4	19	55				
Second Equation,	—	8	25	4	Arg. 3d equation.				Arg. 2d equation.							
Time twice equated,	22	5	26	11												
Third Equation,			—	58												
Time thrice equated,	22	5	25	13												
Fourth Equation,			—	12												
True time at London,	22	5	25	1												
Add for Alexandria,		2	1	27												
True time there,	22	7	26	28												

Thus it appears, that the true time of Full Moon at Alexandria, in September, old style, the year before Christ 201, was the 22d day, at 26 minutes 28 seconds after seven in the evening.

EXAMPLE VI.

Required the true time of Full Moon at Babylon *in* October, *Old Style, the* 4008 *year before the first year of Christ, or* 4007 *before the year of his birth?*
The years 4007 added to 1793, make 5800, or 58 centuries.

By the Precepts.	New Moon.				Sun's Anomaly.				Moon's Anomaly.				Sun from Node.			
	D.	H.	M	S.	s	°	′	″	s	°	′	″	s	°	′	″
March 1793,	30	9	13	55	9	10	16	11	8	7	37	58	7	6	18	26
Subtract 5800 years,	15	12	38	7	10	21	35	0	6	24	43	0	9	13	1	0
N. M. bef. Chr. 4007,	14	20	35	48	10	18	41	11	1	12	54	58	9	23	17	26
Add { 7 Lunations,	206	17	8	21	6	23	44	15	6	0	43	3	7	4	41	38
{ half Lunations.	14	18	22	2	0	14	33	10	6	12	54	30	0	15	20	7
Full Moon, October,	22	8	6	11	5	26	58	36	1	26	32	31	5	13	19	11
First Equation,		—	13	26	1	26	27	26		—	5	5	Sun from Node, and Argument fourth equation.			
Time once equated,	22	7	52	45	4	0	31	10	1	26	27	26				
Second Equation,	+	8	29	21	Arg. 3d equation.				Arg. 2d equation.							
Time twice equated,	22	16	22	6												
Third Equation,		—	4	10												
Time thrice equated,	22	16	17	56												
Fourth Equation,			—	51												
Full Moon at London,	22	16	17	5												
Add for Babylon,		2	25	41												
True time there,	22	18	42	46												

So that, on the meridian of London, the true time was October 23d, at 17 minutes 5 seconds past four in the morning; but at Babylon, the true time was October 23d, at 42 minutes 46 seconds past six in the morning.—This is supposed by some to have been the year of the creation.

EXAMPLE

458 *To calculate the true time of New or Full Moon in any given year and month after the 18th century.*

Precept I. Find a year of the same number in the 18th century with that of the year proposed, and take out the mean time and anomalies, &c. of new moon in March, old style, for that year, in Table I.

II. Take so many years from Table VI. as when added to the abovementioned year in the 18th century will answer to the given year in which the new or full moon is required; and take out the first new moon, with its anomalies for these complete centuries.

III. Add all these together, and then work in all respects as above shown, only remember to subtract a lunation and its anomalies, when the abovesaid addition carries the new moon beyond the 31st of March; as in the following example.

EXAMPLE VII.

Required the true time of New Moon in July, *Old Style*, A. D. 2180?

Four centuries (or 400 years) added to A. D. 1780, make 2180.

By the Precepts.	New Moon.				Sun's Anomaly.				Moon's Anomaly.				Sun from Node.			
	D.	H	M.	S.	s	°	′	″	s	°	′	″	s	°	′	″
March 1780,	23	23	1	44	9	4	18	13	1	21	7	47	10	18	21	1
Add 400 years.	17	8	43	29	0	13	24	0	10	1	28	0	6	17	49	0
From the sum	41	7	45	13	9	17	42	13	11	22	35	47		6	10	1
Subtract 1 Lunation,	29	12	44	3	0	29	6	19	0	25	49	0		0	40	14
New Moon March 2180,	11	19	1	10	8	18	35	54	10	26	46	47	4	5	29	47
Add 4 Lunations,	118	2	56	12	3	26	25	17	3	13	16	2	4	2	40	56
New Moon July 2180.	7	21	57	22	0	15	1	11	2	10	2	49	8	8	10	43
First Equation,	—	1	3	39	3	9	38	37		—	24	12	Sun from Node, and Argument fourth equation.			
Time once equated,	7	20	53	43	10	5	22	34	2	9	38	37				
Second Equation,	+	9	24	8	Arg. 3d equation.				Arg. 2d equation.							
Time twice equated,	8	6	17	51												
Third Equation,		+	3	56												
Time thrice equated,	8	6	21	47												
Fourth Equation,		+	1	8												
True time, July,	8	6	22	55												

True time, July 8th, at 22 minutes 55 seconds past six in the evening.

In keeping by the old style, we are always sure to be right, by adding or subtracting whole hundreds of years to or from any given year in the 18th century. But in the new style we may be very apt to make mistakes, on account of the leap-year's not coming in regularly every fourth year: and therefore, when we go without the limits of the 18th century, we had best keep to the old style, and at the end of the calculation reduce the time to the new. Thus, in the 22d century there will be fourteen days difference between the styles; and therefore the true time of new moon in this last example being reduced to the new style, will be the 22d of July, at 22 minutes 55 seconds past six in the evening.

459 *To calculate the true place of the Sun for any given moment of time.*

Precept I. In Table XII. find the next lesser year in number to that in which the sun's place is sought, and write out his mean longitude and anomaly answering thereto: to which add his mean motion and anomaly for the complete residue of years, months, days, hours, minutes and seconds, down to the given time, and this will be the sun's mean place and anomaly at that time, in the old style, provided the said time be in any year after the Christian æra. *See the first following Example.*

II. Enter Table XIII. with the sun's mean anomaly, and making proportions for the odd minutes and seconds thereof, take out the equation of the sun's centre: which, being applied to his mean place as the title *Add* or *Subtract* directs, will give his true place or longitude from the vernal equinox, at the time for which it was required.

III. To calculate the sun's place for any time in a given year before the Christian æra, take out his mean longitude and anomaly for the first year thereof, and from these numbers subtract the mean motions and anomalies for the complete hundreds or thousands next above the given year; and to the remainders, add those for the residue of years, months, &c. and then work in all respects as above. *See the second Example following.*

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EXAMPLE I.

Required the Sun's true place, March 20th *Old Style,* 1764, *at* 22 *hours* 30 *minutes* 25 *seconds past noon? In common reckoning,* March 21st, *at* 10 *hours* 30 *minutes* 25 *seconds in the forenoon.*

		Sun's Longitude.				Sun's Anomaly.			
		s	°	′	″	s	°	′	″
To the radical year after Christ — —	1701	9	20	43	50	6	13	1	0
Add complete years — —	60	0	0	27	12	11	29	26	0
	3	11	29	17	0	11	29	14	0
	March	1	28	9	11	1	28	9	0
Bissextile Days -	20		20	41	55		20	41	55
Hours -	22			54	13			54	13
Minutes -	30			1	14			1	14
Seconds -	25				1				1
Sun's mean place at the given time - - - -		0	10	14	36	9	1	27	23
Equation of the Sun's centre, add - - - -			1	55	36	Mean Anomaly.			
Sun' true place at the same time - - - -		0	12	10	12 or ♈	12	10	12	

EXAMPLE II.

Required the Sun's true place, October 23d, *Old Style, at* 16 *hours* 57 *minutes past noon, in the* 4008th *year before the year of Christ* 1; *which was the* 4007th *before the year of his birth, and the year of Julian period* 706.

By the Precepts.		Sun's Longitude.				Sun's Anomaly.			
		s	°	′	″	s	°	′	″
From the radical numbers after Christ - - -	1	9	7	53	10	6	28	48	0
Subtract those for 5000 complete years - - - -		1	7	46	40	10	13	25	0
Remains for a new radix		8	0	6	30	8	15	23	0
To which add, to bring it to the given time: complete years - -	900	0	6	48	0	11	21	37	0
	80	0	0	36	16	11	29	15	0
	12	0	0	5	26	11	29	53	0
	October	8	29	4	54	8	29	4	0
Days	23		22	40	12		22	40	12
Hours	16			39	26			39	26
Minutes,	57			2	20			2	20
Sun's mean place at the given time - - -		6	0	3	4	5	28	33	58
Equation of the sun's centre subtract - - - -				3	4	Sun's Anomaly.			
Sun's true place at the same time - - - - -		6	0	0	0 or ♎	0	0	0	

So that in the meridian of London, the sun was then just entering the sign ♎ Libra, and consequently was upon the point of the autumnal equinox.

If to the above time of the autumnal equinox at London, we add 2 hours 25 minutes 41 seconds for the longitude of Babylon, we shall have for the time of the same equinox, at that place, October 23d, at 19 hours 22 minutes 41 seconds; which, in the common way of reckoning, is October 24th, at 22 minutes 41 seconds past seven in the morning.

And it appears by Example VI. that in the same year, the true time of full moon at Babylon was October 23d, at 42 minutes 46 seconds after six in the morning; so that the autumnal equinox was on the day next after the day of full moon.—The dominical letter for that year was G, and consequently the 24th of October was on a Wednesday.

To find the Sun's distance from the Moon's ascending node, at the time of any given new or full moon; and consequently to know whether there is an eclipse at that time, or not. 460

The sun's distance from the moon's ascending node is the argument for finding the moon's fourth equation in the syzygies, and therefore it is taken into all the foregoing examples in finding the times thereof. Thus, at the time of mean new moon in April 1764, the sun's mean distance from the ascending node, is $0^s\ 5^\circ\ 35'\ 2''$. See Example I. p. 562.

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The descending node is opposite to the ascending one, and they are just six signs distant from each other.

When the sun is within 17 degrees of either of the nodes at the time of new moon, he will be eclipsed at that time: and when he is within 12 degrees of either of the nodes at the time of full moon, the moon will be then eclipsed. Thus we find, that there was an eclipse of the sun at the time of new moon in April 1764.

But the true time of that new moon comes out by the equations to be 50 minutes 46 seconds later than the mean time thereof, by comparing these times in the above example: and therefore we must add the sun's motion from the node during that interval to the above mean distance $0^s\ 5°\ 35'\ 2''$, which motion is found in Table XII. for 50 minutes 46 seconds, to be $2'\ 12''$. And to this we must apply the equation of the sun's mean distance from the node in Table XV. found by the sun's anomaly, which at the mean time of new moon in Example I. is $9^s\ 1°\ 26'\ 19''$; and then we shall have the sun's true distance from the node, at the true time of new moon, as follows:

	Sun from Node.			
	s	o	′	″
At the mean time of new moon in April 1764	0	5	35	2
Sun's motion from the node for { 50 minutes			2	10
{ 46 seconds				2
Sun's mean distance from node at true new moon	0	5	37	14
Equation of mean distance from node, add		2	5	0
Sun's true distance from the ascending node	0	7	42	14

Which being far within the above limit of 17 degrees, shows that the sun must then have been eclipsed.

And now we shall show how to project this, or any other eclipse, either of the sun or moon.

461 *To project an Eclipse of the Sun.*

In order to this, we must find the 10 following elements, by means of the tables.

1. The true time of conjunction of the sun and moon; and at that time. 2. The semidiameter of the earth's disk, as seen from the moon, which is equal to the moon's horizontal parallax. 3. The sun's distance from the solstitial colure to which he is then nearest. 4. The sun's declination. 5. The angle of the moon's visible path with the ecliptic. 6. The moon's latitude. 7. The moon's true horary motion from the sun. 8. The sun's semidiameter. 9. The moon's. 10. The semidiameter of the penumbra.

We shall now proceed to find these elements for the sun's eclipse in April 1764.

462 *To find the true time of new moon.* This, by Example I. p. 562, is found to be on the first day of the said month, at 30 minutes 25 seconds after ten in the morning.

463 2. *To find the moon's horizontal parallax, or semidiameter of the earth's disk, as seen from the moon.* Enter Table XVII. with the signs and degrees of the moon's anomally (making proportions, because the anomaly is in the table only to every 6th degree), and thereby take out the moon's horizontal parallax; which for the above time, answering to the anomaly $11^s\ 9°\ 24'\ 21''$, is $54'\ 43''$.

3. *To find the sun's distance from the nearest solstice, viz. the beginning of Cancer, which is 3^s or 90° from the beginning of Aries.* It appears by Example I. in p. 566 (where the sun's place is calculated to the above time of new moon), that the sun's longitude from the beginning of Aries is then $0^s\ 12°\ 10'\ 12''$; that is, the sun's place at that time is ♈ Aries, $12°\ 10'\ 12''$. 464

	s	o	′	″
Therefore from - -	3	0	0	0
Subtract the Sun's longitude or place	0	12	10	12
Remains the sun's distance from the solstice ♋ =	2	17	49	48

Or $77°\ 49'\ 48''$; each sign containing 30 degrees.

5. *To find the sun's declination.* Enter Table XIV. with the signs and degrees of the sun's true place, viz. $0^s\ 12°$, and making proportions for the $10'\ 12''$, take out the sun's declination answering to his true place, and it will be found to be $4°\ 49'$ north. 465

5. *To find the moon's latitude.* This depends on her distance from her ascending node, which is the same as the sun's distance from it at the time of new moon; and is thereby found in Table XVI. 466

But we have already found, that the sun's equated distance from the ascending node, at the time of new moon in April 1764, is $0^s\ 7°\ 42'\ 14''$. See above.

Therefore, enter Table XVI. with 0 signs at the top, and 7 and 8 degrees at the left hand, and take out $36'$ and $39''$, the latitude for 7°; and $41'\ 51''$, the latitude for 8°: and by making proportions between these latitudes for the $42'\ 14''$, by which the moon's distance from the node exceeds 7 degrees; her true latitude will be found to be $40'\ 18''$ north ascending.

6. *To find the moon's true horary motion from the sun.* With the moon's anomaly, viz. $11^s\ 9°\ 24'\ 21''$, Table XVII. and take out the moon's horary motion; which, by making proportions in that table, will be found to be $30'\ 22''$. Then, when the sun's anomaly, $9^s\ 1°\ 26'\ 19''$, take out his horary motion $2'\ 28''$ from the same table: and subtracting the latter from the former, there will remain $27'\ 54''$ for the moon's true horary motion from the sun. 467

7. *To find the angle of the moon's visible path with the ecliptic.* This, in the projection of eclipses, may be always rated at $5°\ 35'$, without any sensible error. 468

8, 9. *To find the semidiameters of the sun and moon.* These are found in the same table, and by the same arguments, as their horary motions. In the present case, the sun's anomaly gives his semidiameters $16'\ 6''$, and the moon's anomaly gives her semidiameter $14'\ 57''$. 469

10. *To find the semidiameter of the penumbra.* Add the moon's semidiameter to the sun's, and their sum will be the semidiameter of the penumbra, viz. $31'\ 3''$. 470

Now collect these elements, that they may be found the more readily when they are wanted in the construction of this eclipse.

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		°	′	″
1. True time of new moon in April, 1764 - -	I	10	30	25
2. Semidiameter of the earth's disk		0	54	53
3. Sun's distance from the nearest solst.		77	49	48
4. Sun's declination, north		4	49	0
5. Moon's latitude, north ascending		0	40	18
6. Moon's horary motion from the sun		0	27	54
7. Angle of the moon's visible path with the ecliptic		5	35	0
8. Sun's semidiameter			16	6
9. Moon's semidiameter			14	57
10. Semidiameter of the penumbra			31	3

To project an Eclipse of the Sun geometrically.

Make a scale of any convenient length, as AC, and divide it into as many equal parts as the earth's semidisk contains minutes of a degree; which, at the time of the eclipse in April 1764, is 54′ 53″. Then, with the whole length of the scale as a radius, describe the semicircle AMB upon the centre C; which semicircle shall represent the northern half of the earth's enlightened disk, as seen from the sun.

Upon the centre C raise the straight line CH, perpendicular to the diameter ACB; so ACB shall be a part of the ecliptic, and CH its axis.

Being provided with a good sector, open it to the radius CA in the line of chords; and taking from thence the chord of 23½ degrees in your compasses, set it off both ways from H, to *g* and to *h*, in the periphery of the semidisk; and draw the straight line *g* V *h*, in which the north pole of the disk will be always found.

When the sun is in Aries, Taurus, Gemini, Cancer, Leo, and Virgo, the north pole of the earth is enlightened by the sun; but whilst the sun is in the other six signs, the south pole is enlightened, and the north pole is in the dark.

And when the sun is in Capricorn, Aquarius, Pisces, Aries, Taurus, and Gemini, the northern half of the earth's axis C XII P lies to the right hand of the axis of the ecliptic, as seen from the sun; and to the left hand, whilst the sun is in the other six signs.

Open the sector till the radius (or distance of the two 90's) of the sines be equal to the length of V *h*, and take the sine of the sun's distance from the solstice (77° 49′ 48″) as nearly as you can guess, in your compasses, from the line of sines, and set off that distance from V to P in the line *g* V *h*, because the earth's axis lies to the right hand of the axis of the ecliptic in this case, the sun being in Aries; and draw the straight line C XII P for the earth's axis, of which P is the north pole. If the earth's axis had lain to the left hand from the axis of the ecliptic, the distance VP would have been set off from V towards *g*.

To draw the parallel of latitude of any given place, as suppose London, or the path of that place on the earth's enlightened disk as seen from the sun, from sunrise till sun-set, take the following method.

Subtract the latitude of London, 51½°, from 90°, and the remainder 38½° will be the co-latitude, which take in your compasses from the line of chords, making CA or CB the radius, and set it from *h* (where the earth's axis meets the periphery of the disk) to VI and VI, and draw the occult or dotted line VI K VI. Then, from the points where this line meets the earth's disk, set off the chord of the sun's declination 4° 49′ to D and F, and to E and G, and connect these points by the two occult lines F XII G and DLE.

Bisect LK XII in K, and through the point K draw the black line VI K VI. Then making CB the radius of a line of sines on the sector, take the co-latitude of London 38½° from the sines in your compasses, and set it both ways from K to VI and VI. These hours will be just in the edge of the disk at the equinoxes, but at no other time in the whole year.

With the extent K VI taken into your compasses, set one foot in K (in the black line below the occult one) as a centre, and with the other foot describe the semicircle VI 7 8 9 10, &c. and divide it into 12 equal parts. Then from these points of division draw the occult lines 7*p*, 8*o*, 9*n*, &c. parallel to the earth's axis C XII P.

With the small extent K XII as a radius, describe the quadrantal arc XII*f*, and divide it into six equal parts, as XII *a*, *ab*, *bc*, *cd*, *de*, and *ef*; and through the division-points *a*, *b*, *c*, *d*, *e*, draw the occult lines VII *e* V, VIII *d* IV, IX *c* III, X *b* II, and XI *a* I, all parallel to VI K VI, and meeting the former occult lines 7 *p* 8 *o*, &c. in the points VII VIII IX X XI, V IV III II and I: which points shall mark the several situations of London on the earth's disk, at these hours respectively, as seen from the sun; and the elliptic curve VI VII VII, &c. being drawn through these points, shall represent the parallel of latitude, or path of London on the disk, as seen from the sun, from its rising to its setting.

N. B. If the sun's declination had been south, the diurnal path of London would have been on the upper side of the line VI K VI, and would have touched the line DLE in L. It is requisite to divide the horary spaces into quarters (as some are in the figure), and, if possible, into minutes also.

Make CB the radius of a line of chords on the sector, and taking therefrom the chord of 5° 35′, the angle of the moon's visible path with the ecliptic, set it off from H to M on the left hand of CH, the axis of the ecliptic, because the moon's latitude is north ascending. Then draw CM for the axis of the moon's orbit, and bisect the angle MCH by the right line C*z*. If the moon's latitude had been north descending, the axis of her orbit would have been on the right hand from the axis of the ecliptic.——N. B. The axis of the moon's orbit lies the same way when her latitude is south ascending as when it is north ascending, and the same way when south descending as when north descending.

Take the moon's latitude 40′ 18″ from the scale C A in your compasses, and set it from *i* to *x* in the bisecting line C*z*, making *ix* parallel to C*y*: and thro' *x*, at right angles to the axis of the moon's orbit CM, draw the straight line N *wxy*S for the path of the penumbra's centre over the earth's disk.—The point *w*, in the axis of the moon's orbit, is that where the penumbra's centre approaches nearest to the centre of the earth's disk, and consequently is the middle of the general eclipse: the point *x* is that where the conjunction

I of

Fig. 199

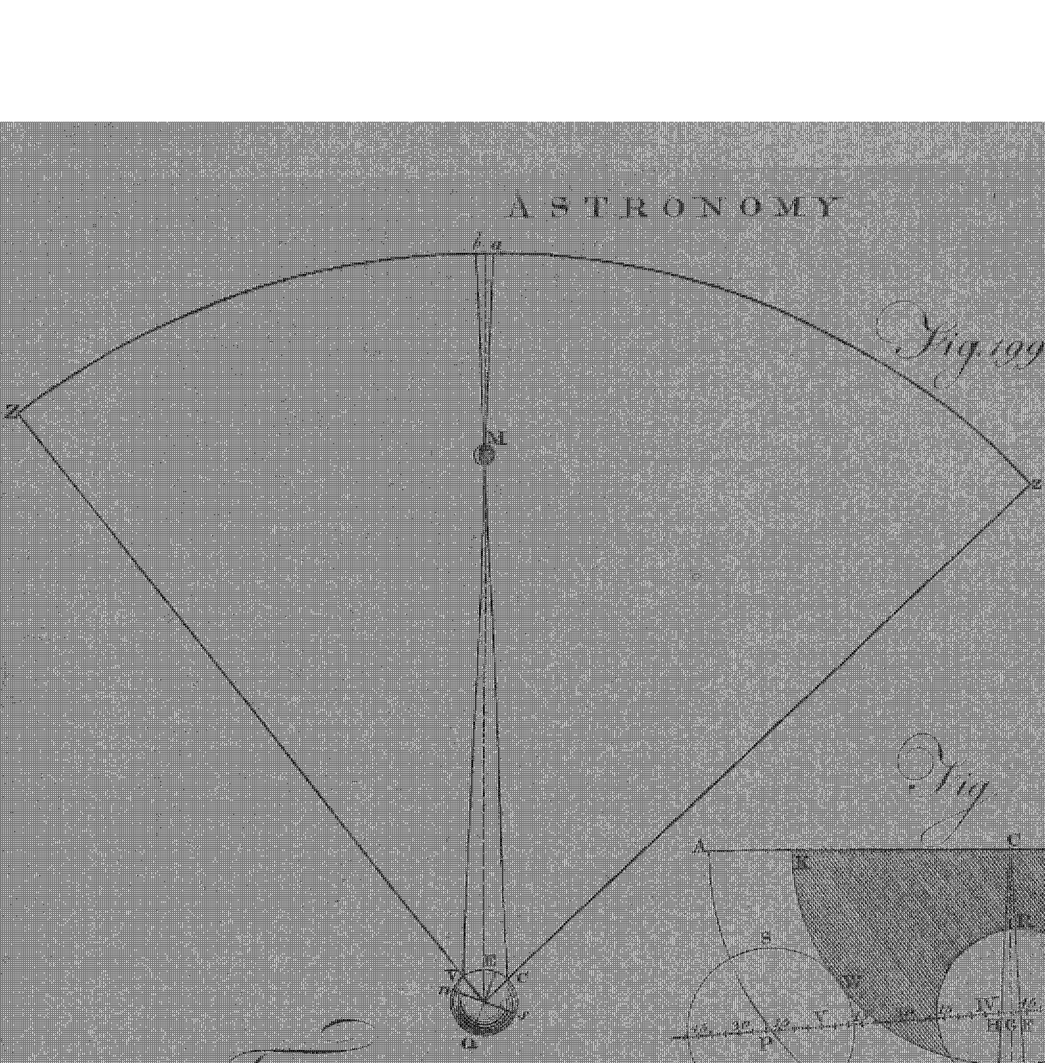


Fig. 202

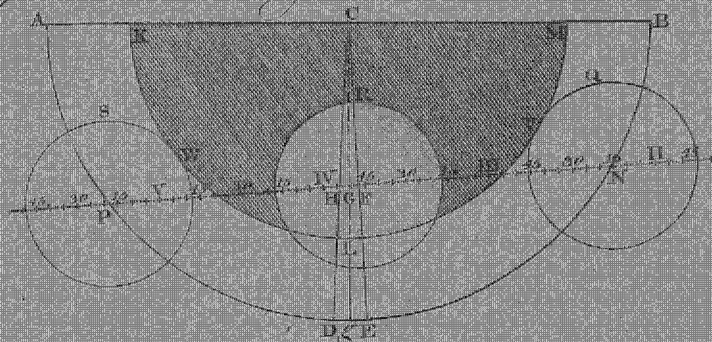
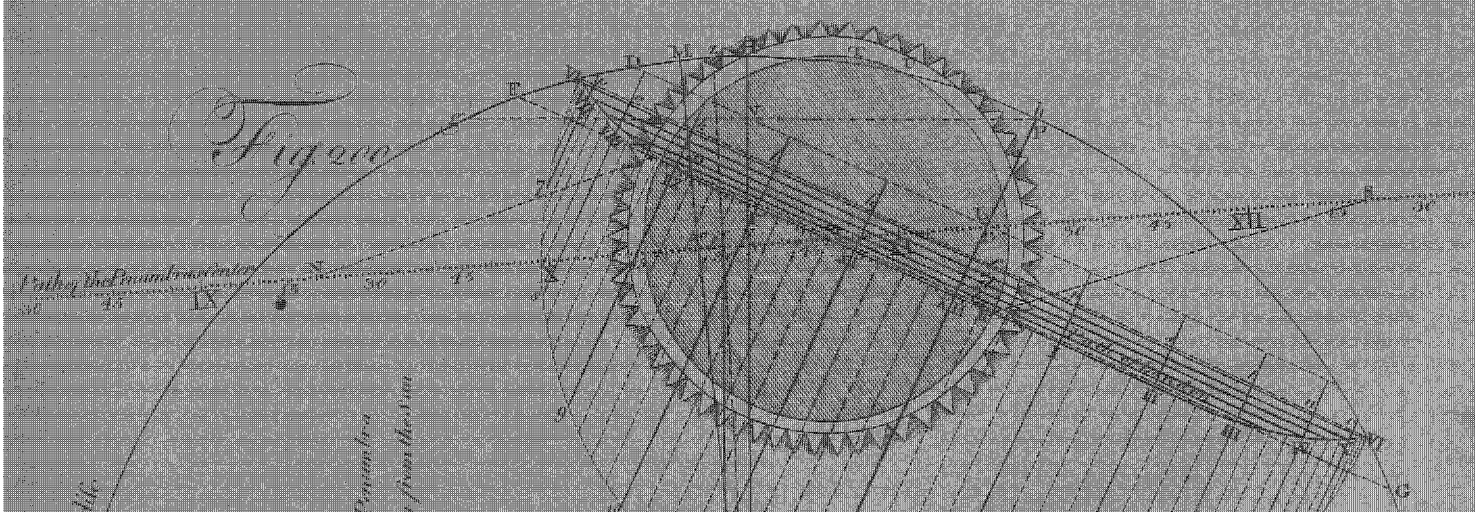


Fig. 201

Fig. 200



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of the sun and moon falls, according to equal time by the tables; and the point y is the ecliptical conjunction of the sun and moon.

Take the moon's true horary motion from the sun, 27′ 54″, in your compasses, from the scale CA (every division of which is a minute of a degree), and with that extent make marks along the path of the penumbra's centre; and divide each space from mark to mark into sixty equal parts or horary minutes, by dots; and set the hours to every 60th minute in such a manner, that the dot signifying the instant of new moon by the tables, may fall into the point x, half way between the axis of the moon's orbit and the axis of the ecliptic; and then, the rest of the dots will show the points of the earth's disk, where the penumbra's centre is at the instants denoted by them, in its transit over the earth.

Apply one side of a square to the line of the penumbra's path, and move the square backwards and forwards until the other side of it cuts the same hour and minute (as at m and m) both in the path of London and in the path of the penumbra's centre; and the particular minute or instant which the square cuts at the same time in both paths, shall be the instant of the visible conjunction of the sun and moon, or greatest obscuration of the sun, at the place for which the construction is made, namely, London, in the present example; and this instant is at 47½ minutes past ten o'clock in the morning; which is 17 minutes five seconds later than the tabular time of true conjunction.

Take the sun's semidiameter, 16′ 6″, in your compasses, from the scale CA, and setting one foot in the path of London, at m, namely at 47½ minutes past ten, with the other foot describe the circle UY, which shall represent the sun's disk as seen from London at the greatest obscuration.—Then take the moon's semidiameter, 14′ 57″, in your compasses from the same scale; and setting one foot in the path of the penumbra's centre at m, in the 47½ minute after ten, with the other foot describe the circle TY for the moon's disk, as seen from London, at the time when the eclipse is at the greatest, and the portion of the sun's disk which is hid or cut off by the moon's will show the quantity of the eclipse at that time; which quantity may be measured on a line equal to the sun's diameter, and divided into 12 equal parts for digits.

Lastly, take the semidiameter of the penumbra, 31′ 3″, from the scale CA in your compasses; and setting one foot in the line of the penumbra's central path, on the left hand from the axis of the ecliptic, direct the other foot toward the path of London; and carry that extent backwards and forwards till both the points of the compasses fall into the same instants in both the paths: and these instants will denote the time when the eclipse begins at London.—Then, do the like on the right hand of the axis of the ecliptic; and where the points of the compasses fall into the same instants in both of the paths, they will show at what time the eclipse ends at London.

These trials give 20 minutes after nine in the morning for the beginning of the eclipse at London, at the points N and O; 47½ minutes after ten, at the points m and n, for the time of greatest obscuration; and 18 minutes after twelve, at R and S, for the time when the eclipse ends; according to mean or equal time.

From these times we may subtract the equation of natural days, &c. 3 minutes 48 seconds, in leap-year April 1, and we shall have the apparent times; namely, 9 hours 16 minutes 12 seconds for the beginning of the eclipse, 10 hours 43 minutes 42 seconds for the time of greatest obscuration, and 12 hours 14 minutes 12 seconds for the time when the eclipse ends. But the best way is to apply this equation to the true equal time of new moon, before the projection be begun; as is done in Example I. For the motion or position of places on the earth's disk answer to apparent or solar time.

In this construction it is supposed, that the angle under which the moon's disk is seen, during the whole time of the eclipse, continues invariably the same; and that the moon's motion is uniform and rectilineal during that time. But these suppositions do not exactly agree with the truth; and therefore, supposing the elements given by the tables to be accurate, yet the times and phases of the eclipse, deduced from its construction, will not answer exactly to what passeth in the heavens; but may be at least two or three minutes wrong, though done with the greatest care. Moreover, the paths of all places of considerable latitudes, are nearer the centre of the earth's disk, as seen from the sun, than those constructions make them: because the disk is projected as if the earth were a perfect sphere although it is known to be a spheroid. Consequently, the moon's shadow will go farther northward in all places of northern latitude, and farther southward in all places of southern latitude, than it is shown to do in these projections.—According to Meyer's Tables, this eclipse was about a quarter of an hour sooner than either these tables, or Mr Flamstead's or Dr Halley's, make it, and was not annular at London. But M. de la Caille's make it almost central.

The projection of lunar eclipses.

When the moon is within 12 degrees of either of her nodes at the time when she is full, she will be eclipsed, otherwise not. 471

We find by example second, page 562, that at the time of mean full moon in May 1762, the sun's distance from the ascending node was only 4° 49′ 35″; and the moon being then opposite to the sun, must have been just as near her descending node, and was therefore eclipsed.

The elements for constructing an eclipse of the moon, are eight in number, as follow:

1. The true time of full moon; and at that time. 472
2. The moon's horizontal parallax. 3. The sun's semidiameter. 4. The moon's. 5. The semidiameter of the earth's shadow at the moon. 6. The moon's latitude. 7. The angle of the moon's visible path with the ecliptic. 8. The moon's true horary motion from the sun.——Therefore,

1. *To find the true time of new or full moon.* Work as already taught in the precepts.—Thus we had the true time of full moon in May 1762 (See Example II. page 562) on the 8th day, at 50 minutes 50 seconds past three o'clock in the morning. 473

2. *To find the moon's horizontal parallax.* Enter Table XVII. with the moon's mean anomaly (at the above full) 9ˢ 2° 42′ 42″, and thereby take out her horizontal parallax, which by making the requisite proportions, will be found to be 57′ 23″. 474

3, 4. *To find the semidiameters of the sun and moon.* Enter Table XVII. with their respective anomalies, the sun's being 10ˢ 7° 27′ 45″ (by the above example) and the moon's 9ˢ 2° 42′ 42″; and thereby take out their respective semidiameters; the sun's 15′ 56″, and the moon's 15′ 38″. 475

476 5. *To find the semidiameter of the earth's shadow at the moon.* Add the sun's horizontal parallax, which is always 10″, to the moon's which in the present case is 57′ 23″, the sum will be 57′ 33″, from which subtract the sun's semidiameter 15′ 56″, and there will remain 41′ 36″ for the semidiameter of that part of the earth's shadow which the moon then passes through.

477 6. *To find the moon's latitude.* Find the sun's true distance from the ascending node (as already taught in page 566) at the true time of full moon; and this distance increased by six signs, will be the moon's true distance from the same node; and consequently the argument for finding her true latitude, as shown in p. 566.

478 Thus, in Example II. the sun's mean distance from the ascending node was 0s 4° 49′ 35″, at the time of mean full moon: but it appears by the example, that the true time thereof was six hours 33 minutes 38 seconds sooner than the mean time; and therefore we must subtract the sun's motion from the node (found in Table XII.) during this interval, from the above mean distance 0s 4° 49′ 35″, in order to have his mean distance from it at the true time of full moon. Then to this apply the equation of his mean distance from the node, found in Table XV. by his mean anomaly 10s 7° 27′ 45″; and lastly add six signs: so shall the moon's true distance from the ascending node be found as follows:

	S	°	′	″
Sun from node at mean full moon	0	4	49	35
His motion from it in { 6 hours			15	35
33 minutes			1	26
38 seconds				2
Sum, subtract from the uppermost line			17	3
Remains his mean distance at true full moon	0	4	32	32
Equation of his mean distance, add		1	38	0
Sun's true distance from the node	0	6	10	32
To which add	6	0	0	0
And the sum will be	6	6	10	32

Which is the moon's true distance from her ascending node at the true time of her being full; and consequently the argument for finding her true latitude at that time.—Therefore, with this argument, enter Table XVI. making proportions between the latitudes belonging to the 6th and 7th degree of the argument at the left hand (the signs being at top) for the 10′ 32″ and it will give 32′ 21″ for the moon's true latitude, which appears by the table to be south descending.

479 7. *To find the angle of the moon's visible path with the ecliptic.* This may be stated at 5° 35′, without any error of consequence in the projection of the eclipse.

480 8. *To find the moon's true horary motion from the sun.* With their respective anomalies take out their horary motions from Table XVII. and the sun's horary motion subtracted from the moon's leaves remaining the moon's true horary motion from the sun: in the present case 30′ 52″.

481 Now collect these elements together for use.

	D.	H.	M.	S.
1. True time of full moon in May, 1762	8	3	50	50
		°	′	″
2. Moon's horizontal parallax		0	57	23
3. Sun's semidiameter		0	15	56
4. Moon's semidiameter		0	15	38
5. Semidiameter of the earth's shadow at the moon		0	41	37
6. Moon's true latitude, south descending		0	32	21
7. Angle of her visible path with the ecliptic		5	35	0
8. Her true horary motion from the sun		0	30	52

These elements being found for the construction of the moon's eclipse in May 1762, proceed as follows:

Make a scale of any convenient length, as WX (fig. 201.), and divide it into 60 equal parts, each part standing for a minute of a degree.

Draw the right line ACB (fig. 202.) for part of the ecliptic, and CD perpendicular thereto for the southern part of its axis; the moon having south latitude.

Add the semidiameters of the moon and earth's shadow together, which in this eclipse will make 57′ 15″; and take this from the scale in your compasses, and setting one foot in the point C as a centre, with the other foot describe the semicircle ADB; in one point of which the moon's centre will be at the beginning of the eclipse, and in another at the end thereof.

Take the semidiameter of the earth's shadow, 41′ 37″, in your compasses from the scale, and setting one foot in the centre C, with the other foot describe the semicircle KLM for the southern half of the earth's shadow, because the moon's latitude is south in this eclipse.

Make CD equal to the radius of a line of chords on the sector, and set off the angle of the moon's visible path with the ecliptic, 5° 35′, from D to E, and draw the right line CFE for the southern half of the axis of the moon's orbit lying to the right hand from the axis of the ecliptic CD, because the moon's latitude is south descending.—It would have been the same way (on the other side of the ecliptic) if her latitude had been north descending; but contrary in both cases, if her latitude had been either north ascending or south ascending.

Bisect the angle DCE by the right line C*g*; in which line the true equal time of opposition of the sun and moon falls, as given by the tables.

Take the moon's latitude, 32′ 21″ from the scale with your compasses, and set it from C to G, in the line CG*g*; ond through the point G, at right angles to CFE, draw the right line PHGFN for the path of the moon's centre. Then, F shall be the point in the earth's shadow, where the moon's centre is at the middle of the eclipse: G, the point where her centre is at the tabular time of her being full; and H, the point where her centre is at the instant of her ecliptical opposition.

Take the moon's horary motion from the sun, 30′ 52″, in your compasses from the scale; and with that extent make marks along the line of the moon's path PGN: then divide each space from mark to mark, into 60 equal parts, or horary minutes, and set the hours to the proper dots in such a manner, that the dot signifying the instant of full moon (viz. 50 minutes 50 seconds after III in the morning) may be in the point G, where the line of the moon's path cuts the line that bisects the angle DCE.

Take the moon's semidiameter, 15′ 38″, in your compasses from the scale, and with that extent, as a radius, upon the points N, F, and P, as centres, describe the circle Q for the moon at the beginning of the eclipse, when she touches the earth's shadow at V; the circle R for the moon at the middle of the eclipse; and the circle S for the moon at the end of the eclipse, just leaving the earth's shadow at W.

The point N denotes the instant when the eclipse began, namely, at 15 minutes 10 seconds after II in the morning: the point F the middle of the eclipse at 47 minutes 44 seconds past III; and the point P the the end of the eclipse, at 18 minutes after V.—At the greatest obscuration the moon was 10 digits eclipsed.

TABLE I. *The mean Time of New Moon, in* March, *Old Style; with the mean Anomalies of the Sun and Moon, and the Sun's mean Distance from the Moon's ascending Node, from* A. D. 1700 *to* A. D. 1800 *inclusive.*

A. D.	Mean N. Moon in March. D. H. M. S.	Sun's mean Anomaly. s ° ′ ″	Moon's mean Anomaly. s ° ′ ″	Sun's mean Dist. from the Node. s ° ′ ″
1700	8 16 11 25	8 19 58 48	1 22 30 37	6 14 31 7
1701	27 13 44 5	9 8 20 59	0 28 7 42	7 23 24 8
1702	16 22 32 41	8 27 36 51	11 7 55 47	8 0 16 55
1703	6 7 21 18	8 16 52 43	9 17 43 52	8 9 19 42
1704	24 4 53 57	9 5 14 54	8 23 20 57	9 18 2 43
1705	13 13 42 34	8 24 30 47	7 3 9 2	9 26 5 30
1706	2 22 31 11	8 13 46 39	5 12 57 7	10 4 8 17
1707	21 20 3 50	9 2 8 50	4 18 34 13	11 12 51 18
1708	10 4 52 27	8 21 24 43	2 28 22 18	11 20 54 5
1709	29 2 25 7	9 9 46 54	2 3 59 24	0 29 37 6
1710	18 11 13 43	8 29 2 47	0 13 47 30	1 7 39 54
1711	7 20 2 20	8 18 18 39	10 23 35 36	1 15 42 41
1712	25 17 34 59	9 6 40 51	9 29 12 42	2 14 25 43
1713	15 2 23 36	8 25 56 43	8 9 0 47	3 2 28 30
1714	4 11 12 13	8 15 12 35	6 18 48 52	3 10 31 17
1715	23 8 44 52	9 3 34 47	5 24 25 57	4 19 14 18
1716	11 17 33 29	8 22 50 39	4 4 14 2	4 27 17 5
1717	1 2 22 5	8 12 6 32	2 14 2 8	5 5 19 52
1718	19 23 54 45	9 0 28 44	1 19 39 13	6 14 2 54
1719	9 8 43 22	8 19 44 37	11 29 27 18	6 22 5 41
1720	27 6 16 1	9 8 6 49	11 5 4 24	8 0 48 43
1721	16 15 4 38	8 27 22 41	9 14 52 29	8 8 51 29
1722	5 23 53 14	8 16 38 33	7 24 40 34	8 16 54 16
1723	24 21 25 54	9 5 0 45	7 0 17 40	9 25 37 18
1724	13 6 14 31	8 24 16 37	5 10 5 45	0 3 40 5
1725	2 15 3 7	8 13 32 29	3 19 53 50	10 11 42 52
1726	21 12 35 47	9 1 54 41	2 25 30 56	11 20 25 54
1727	10 21 24 23	8 21 10 34	1 5 19 1	11 28 28 41
1728	28 18 57 3	9 9 52 46	0 10 56 7	1 7 11 42
1729	18 3 45 40	8 28 48 39	10 20 44 12	1 15 14 29
1730	7 12 34 16	8 18 4 31	9 0 32 17	1 23 17 16
1731	26 10 6 56	9 6 26 42	8 6 9 23	3 2 0 17
1732	14 18 55 33	8 25 42 34	6 15 57 28	3 10 3 4
1733	4 3 44 9	8 14 58 26	4 25 45 38	3 18 5 51
1734	23 1 16 49	9 3 20 38	4 1 22 39	4 26 48 53
1735	12 10 5 25	8 22 36 30	2 11 10 44	5 4 51 40
1736	0 18 54 2	8 11 52 22	0 20 58 49	5 12 54 27
1737	19 16 26 42	9 0 14 34	11 26 35 55	6 21 37 29
1738	9 1 15 18	8 19 30 26	10 6 24 0	6 29 40 16
1739	27 22 47 58	9 7 52 38	9 12 1 6	8 8 23 18
1740	16 7 36 34	8 27 8 30	7 21 49 11	8 16 26 5
1741	5 16 25 11	8 16 24 22	6 1 37 16	8 24 28 52
1742	42 13 57 52	9 4 46 34	5 7 14 22	10 3 11 54
1743	3 22 46 27	8 24 2 27	3 17 2 27	10 1 14 41
1744	2 7 35 4	8 13 18 20	1 26 50 32	10 19 17 28
1745	21 5 7 44	9 1 40 32	1 2 27 38	11 28 0 30
1746	10 13 56 20	8 20 56 24	11 12 15 43	0 6 3 17
1747	29 11 29 0	9 9 98 36	10 17 52 49	1 14 46 19
1748	17 20 17 36	8 28 34 28	8 27 40 54	1 22 49 5
1749	7 5 6 13	8 17 50 20	7 7 28 59	2 0 51 52
1750	26 2 38 53	9 6 12 32	6 13 6 5	3 9 34 53
1751	15 11 27 29	8 25 28 24	4 22 54 10	3 17 37 40
1753	22 17 48 45	9 3 6 28	2 8 19 21	5 4 23 28
1754	12 2 37 22	8 22 22 20	0 18 7 26	5 12 26 15
1755	1 11 25 59	8 11 38 12	10 27 55 31	5 20 29 2
1756	19 8 58 38	9 0 0 24	10 3 32 37	6 29 12 3
1757	8 17 47 15	8 19 16 16	8 13 20 42	7 7 14 50
1758	27 15 19 54	9 7 38 28	7 18 57 48	8 15 57 52
1759	17 0 8 31	8 26 54 20	5 28 45 54	8 24 0 39
1760	5 8 57 8	8 16 10 12	4 8 34 0	9 2 3 26
1761	24 6 29 47	9 4 32 24	3 14 11 6	10 10 46 27
1762	13 15 18 24	8 23 48 16	1 23 59 11	10 18 49 14
1763	3 0 7 1	8 13 4 8	0 3 47 16	10 26 52 1
1764	20 21 39 40	9 1 26 20	11 9 24 21	0 5 35 2
1765	10 6 28 17	8 20 42 13	9 19 12 26	0 13 37 49
1766	29 4 0 56	9 9 4 20	8 24 49 32	1 22 20 51
1767	18 12 49 33	8 28 20 17	7 4 37 37	2 0 23 38
1768	6 21 38 10	8 17 36 9	5 14 25 42	2 8 26 25
1769	25 19 10 40	9 5 58 21	4 20 2 48	3 17 9 27
1770	15 3 59 26	8 25 14 13	2 29 50 53	3 25 12 14
1771	4 12 48 2	8 14 30 5	1 9 38 58	4 3 15 1
1772	22 10 20 43	9 2 52 17	0 15 16 4	5 11 58 3
1773	11 19 9 19	8 22 8 9	10 25 4 9	5 20 0 50
1774	1 3 57 55	8 11 24 1	9 4 52 14	5 28 3 37
1775	20 1 30 35	8 29 46 13	8 10 29 20	7 6 46 38
1776	8 10 19 12	8 19 2 5	6 20 17 25	7 14 49 25
1777	27 7 51 51	9 7 24 17	5 25 54 31	8 23 32 26
1778	16 16 40 28	8 26 40 9	4 5 42 36	9 1 35 13
1779	6 1 29 4	8 15 56 1	2 15 30 41	9 9 38 0
1780	23 23 1 44	8 4 18 13	1 21 7 47	10 18 21 1
1781	13 7 50 21	8 23 34 5	0 0 55 52	10 26 23 48
1782	2 16 38 57	8 12 49 58	10 10 43 57	11 4 26 35
1783	21 14 11 37	9 1 12 10	9 16 21 3	0 13 9 36
1784	9 23 0 13	8 20 28 3	7 26 9 8	0 21 12 23
1785	28 20 32 53	9 8 50 15	7 1 46 14	1 29 55 25
1786	18 5 21 30	8 28 6 7	5 11 34 19	2 7 58 12
1787	7 14 10 6	8 17 21 59	3 21 22 24	2 16 0 59
1788	25 11 42 46	9 5 44 11	2 26 59 30	3 24 44 1
1789	14 20 31 23	8 25 0 3	1 6 47 35	4 2 46 48
1790	4 5 19 59	8 14 15 55	11 16 35 40	4 10 49 35
1791	23 2 52 39	9 2 38 7	10 22 12 46	5 19 32 37
1792	11 11 41 15	8 21 53 59	9 2 0 52	5 27 35 24
1793	30 9 13 55	9 10 16 11	8 7 37 58	7 6 18 26
1794	19 18 2 32	8 29 32 3	6 17 26 4	7 14 21 13
1795	9 2 51 8	8 18 47 55	4 27 14 9	7 22 24 0
1796	27 0 23 48	9 7 10 7	4 2 51 14	9 1 7 1
1797	16 9 12 24	8 26 25 59	2 12 39 19	9 9 9 48
1798	5 18 1 1	8 15 41 51	0 22 27 25	9 17 12 35
1799	24 15 33 41	9 4 4 3	11 28 4 31	10 25 55 37
1800	13 0 22 17	8 23 19 55	10 7 52 36	11 3 58 24

TABLE II. *Mean New Moon, &c.* in March, *New Style, from* A. D. 1790 *to* A. D. 1840.

Y. of Chr.	Mean N. Moon in March.				Sun's mean Anomaly.				Moon's mean Anomaly.				Sun's mean Dif. from the Node.			
	D.	H.	M.	S.	s	°	'	"	s	°	'	"	s	°	'	"
1790	15	5	19	59	8	14	15	55	11	16	35	40	4	10	49	35
1791	4	14	8	35	8	3	31	47	9	26	23	45	4	18	52	22
1792	22	11	41	15	8	21	53	59	9	2	0	52	5	27	35	24
1793	11	20	29	51	8	11	9	51	7	11	48	57	6	5	38	11
1794	30	18	2	32	8	29	32	3	6	17	26	4	7	14	21	13
1795	20	2	51	8	8	18	47	55	4	27	14	9	7	22	24	0
1796	8	11	39	44	8	8	3	47	3	7	2	14	8	0	26	47
1797	27	9	12	24	8	26	25	59	2	12	39	19	9	9	9	48
1798	16	18	1	1	8	15	41	51	0	22	27	25	9	17	12	35
1799	6	2	49	37	8	4	57	43	11	2	15	30	9	25	15	22
1800	25	0	22	17	8	23	19	55	10	7	52	36	11	3	58	24
1801	14	9	10	54	8	12	35	47	8	17	40	41	11	12	1	9
1802	3	17	59	29	8	1	51	39	6	27	28	46	11	20	3	56
1803	22	15	32	10	8	20	13	52	6	3	5	51	0	28	46	57
1804	11	0	20	46	8	9	29	44	4	12	53	56	1	6	49	45
1805	29	21	53	26	8	27	51	56	3	18	31	2	2	15	32	46
1806	19	6	42	2	8	17	7	48	1	28	19	7	2	23	35	33
1807	8	15	30	39	8	6	23	40	0	8	7	12	3	8	38	21
1808	26	13	3	19	8	24	45	52	11	13	44	18	4	10	21	22
1809	15	21	51	55	8	14	1	44	9	23	32	23	4	18	24	9
1810	5	6	40	32	8	3	17	36	8	3	20	28	4	26	26	56
1811	24	4	13	12	8	21	39	48	7	8	57	34	6	5	9	58
1812	12	13	1	48	8	10	55	40	5	18	45	39	6	13	12	45
1813	1	21	50	24	8	0	11	32	3	28	33	44	6	21	15	32
1814	20	19	23	5	8	18	33	44	3	4	10	50	7	29	58	33
1815	10	4	11	41	8	7	49	36	1	13	58	55	8	8	1	20
1816	28	1	44	21	8	26	11	48	0	19	36	1	9	16	44	21
1817	17	10	32	57	8	15	27	40	10	29	24	6	9	24	47	8
1818	6	19	21	33	8	4	43	32	9	9	12	11	10	2	49	55
1819	25	16	54	14	8	23	5	44	8	14	49	17	11	11	32	55
1820	14	21	42	50	8	12	21	37	6	24	37	22	11	19	35	43
1821	3	10	31	26	8	1	37	29	5	4	25	27	11	27	38	30
1822	22	8	4	6	8	19	59	42	4	10	2	33	1	6	21	31
1823	11	16	52	43	8	9	15	34	2	19	50	38	1	14	24	18
1824	29	14	25	23	8	27	37	46	1	25	27	44	2	23	7	20
1825	18	23	13	59	8	16	53	38	0	5	15	49	3	1	10	7
1826	8	8	2	35	8	6	9	30	10	15	3	54	3	9	12	54
1827	27	5	35	16	8	24	31	42	9	20	41	0	4	17	55	56
1828	15	14	23	52	8	13	47	34	8	0	29	5	4	25	58	43
1829	4	23	12	28	8	3	3	26	6	10	17	10	5	4	1	30
1830	23	20	45	8	8	21	25	38	5	15	54	17	6	12	44	32
1831	13	5	33	44	8	10	41	30	3	25	42	22	6	20	47	19
1832	31	3	6	25	8	29	3	42	3	1	19	29	7	29	30	21
1833	20	11	55	1	8	18	19	34	1	11	7	34	8	7	33	8
1834	9	20	43	37	8	7	35	26	11	20	55	39	8	15	35	55
1835	28	18	16	17	8	25	57	38	10	26	32	44	9	24	18	56
1836	17	3	4	54	8	15	13	30	9	6	20	50	10	2	21	43
1837	6	11	53	30	8	4	29	22	7	16	8	55	10	10	24	30
1838	25	9	26	10	8	22	51	34	6	21	46	1	11	19	7	32
1839	14	18	14	46	8	12	7	26	5	1	34	6	11	27	10	18
1840	3	3	3	22	8	1	23	18	3	11	22	11	0	5	13	5

TABLE III. *Mean Anomalies, and Sun's mean Distance from the Node for* 13½ *mean Lunations.*

	Mean Lunations.				Sun's mean Anomaly.				Moon's mean Anomaly.				Sun's mean Dif from the Node.			
N	D.	H.	M.	S.	s	°	'	"	s	°	'	"	s	°	'	"
1	29	12	44	3	0	29	6	19	0	25	49	0	1	0	40	14
2	59	1	28	6	1	28	12	39	1	21	38	1	2	1	20	28
3	88	14	12	9	2	27	18	58	2	17	27	1	3	2	0	42
4	118	2	56	12	3	26	25	17	3	13	16	2	4	2	40	56
5	147	15	40	15	4	25	31	37	4	9	5	2	5	3	21	10
6	177	4	24	18	5	24	37	56	5	4	54	3	6	4	1	24
7	206	17	8	21	6	23	44	15	6	0	43	3	7	4	41	38
8	236	5	52	24	7	22	50	35	6	26	32	3	8	5	21	52
9	265	18	36	27	8	21	56	54	7	22	21	4	9	6	2	6
10	295	7	20	30	9	21	3	14	8	18	10	4	10	6	42	20
11	324	20	4	33	10	20	9	33	9	13	59	5	11	7	22	34
12	354	8	48	36	11	19	15	52	10	9	48	5	0	8	2	47
13	383	21	32	40	0	18	22	12	11	5	37	6	1	8	43	1
½	14	18	22	2	0	14	33	10	6	12	54	30	0	15	20	7

TABLE IV. *The Days of the Year, reckoned from the beginning of* March.

Days.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
1	1	32	62	93	123	154	185	215	246	276	307	338
2	2	33	63	94	124	155	186	216	247	277	308	339
3	3	34	64	95	125	156	187	217	248	278	309	340
4	4	35	65	96	126	157	188	218	249	279	310	341
5	5	36	66	97	127	158	189	219	250	280	311	342
6	6	37	67	98	128	159	190	220	251	281	312	343
7	7	38	68	99	129	160	191	221	252	282	313	344
8	8	39	69	100	130	161	192	222	253	283	314	345
9	9	40	70	101	131	162	193	223	254	284	315	346
10	10	41	71	102	132	163	194	224	255	285	316	347
11	11	42	72	103	133	164	195	225	256	286	317	348
12	12	43	73	104	134	165	196	226	257	287	318	349
13	13	44	74	105	135	166	197	227	258	288	319	350
14	14	45	75	106	136	167	198	228	259	289	320	351
15	15	46	76	107	137	168	199	229	260	290	321	352
16	16	47	77	108	138	169	200	230	261	291	322	353
17	17	48	78	109	139	170	201	231	262	292	323	354
18	18	49	79	110	140	171	202	232	263	293	324	355
19	19	50	80	111	141	172	203	233	264	294	325	356
20	20	51	81	112	142	173	204	234	265	295	326	357
21	21	52	82	113	143	174	205	235	266	296	327	358
22	22	53	83	114	144	175	206	236	267	297	328	359
23	23	54	84	115	145	176	207	237	268	298	329	360
24	24	55	85	116	146	177	208	238	269	299	330	361
25	25	56	86	117	147	178	209	239	270	300	331	362
26	26	57	87	118	148	179	210	240	271	301	332	363
27	27	58	88	119	149	180	211	241	272	302	333	364
28	28	59	89	120	150	181	212	242	273	303	334	365
29	29	60	90	121	151	182	213	243	274	304	335	366
30	30	61	91	122	152	183	214	244	275	305	336	
31	31		92		153	184		245		306	337	

Fig. 203

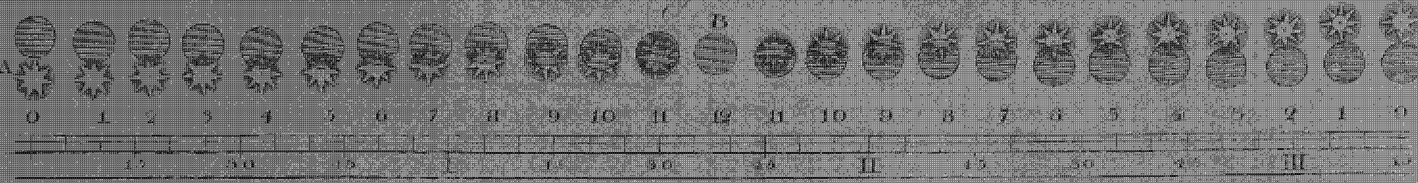

Fig. 204

Northern Hemisphere with the Figures of the Constellations

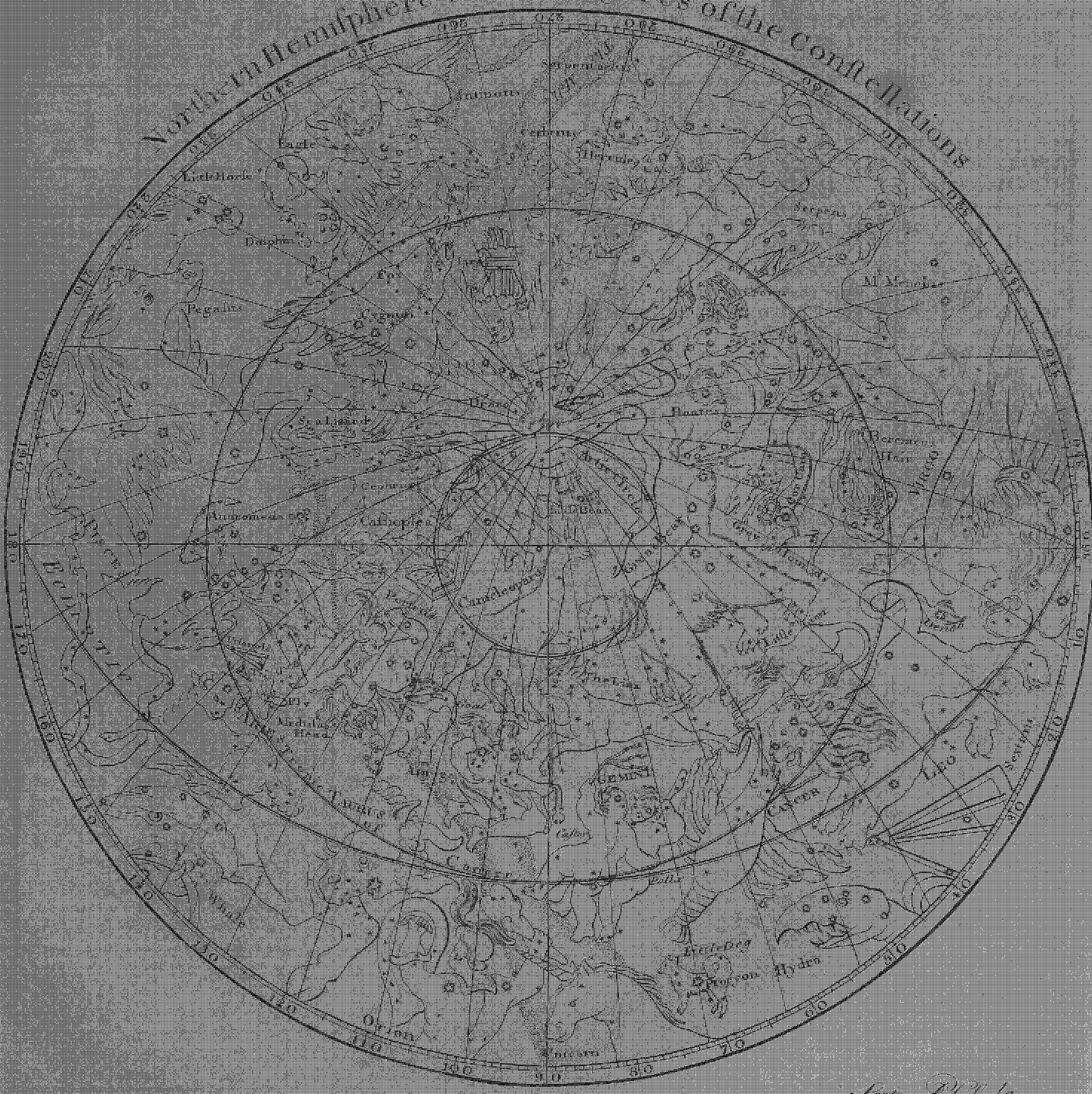

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TABLE V. *Mean Lunations from* 1 *to* 100000.

Lunat.	Days. Decimal Parts.	Days.	Hou.	M.	S.	Th.	Fo.
1	29.530590851080 =	29	12	44	3	2	58
2	59.061181702160	59	1	28	6	5	57
3	88.591772553240	88	14	12	9	8	55
4	118.122363404320	118	2	56	12	11	53
5	147.652954255401	147	15	40	15	14	52
6	177.183545106481	177	4	24	18	17	50
7	206.714135957561	206	17	8	21	20	48
8	236.244726808641	236	5	52	24	23	47
9	265.775317659722	265	18	36	27	26	45
10	295.305908851080	295	7	20	30	29	43
20	590.611817702160	590	14	41	0	59	26
30	885.917725553240	885	22	1	31	29	10
40	1181.223634043200	1181	5	22	1	58	53
50	1476.529542554011	1476	12	42	32	28	36
60	1771.835451064811	1771	20	3	2	58	19
70	2067.141359575611	2067	3	23	33	28	2
80	2362.447268086411	2362	10	44	3	57	46
90	2657.753176597222	2657	18	4	34	27	29
100	2953.05908851080	2953	1	25	4	57	12
200	5906.11817021600	5906	2	50	9	54	24
300	8859.17725532400	8859	4	15	14	51	36
400	11812.2363404320	11812	5	40	19	48	48
500	14765.2954255401	14765	7	5	24	46	0
600	17718.3545106481	17718	8	30	29	43	12
700	20671.4135957561	20671	9	55	34	40	24
800	23624.4726808641	23624	11	20	39	37	36
900	26577.5317659722	26577	12	45	44	34	48
1000	29530.590851080	29530	14	10	49	32	0
2000	59061.181702160	59061	4	21	39	4	0
3000	88591.772553240	88591	18	32	28	36	0
4000	118122.363404320	118122	8	43	18	8	0
5000	147652.954255401	147652	22	54	7	40	0
6000	177183.545106481	177183	13	4	57	12	0
7000	206714.135957561	206714	3	15	46	44	0
8000	236244.726808641	236244	17	26	36	16	0
9000	265775.317659722	265775	7	37	25	48	0
10000	295305.90851080	295305	21	48	15	20	0
20000	590611.81702160	590611	19	36	30	40	0
30000	885917.72553240	885917	17	24	46	0	0
40000	1181223.63404320	1181223	15	13	1	20	0
50000	1476529.54255401	1476529	13	1	16	40	0
60000	1771835.45106481	1771835	10	49	32	0	0
70000	2067141.35957561	2067141	8	37	47	20	0
80000	2362447.26808641	2362447	6	25	2	40	0
90000	2657753.17659722	2657753	4	14	18	0	0
100000	2953059.0851080	2953059	2	2	33	20	0

TABLE VI. *The first mean New Moon, with the mean Anomalies of the Sun and Moon, and the Sun's mean Distance from the Ascending Node, next after complete Centuries of Julian years.*

Lunations	Julian Years.	First New Moon. D.	H.	M.	S.	Sun's Mean Anomaly. s	°	′	M.'s mean Anomaly. s	°	′	Sun from Node. s	°	′
1237	100	4	8	10	52	0	3	21	8	15	22	4	19	27
2474	200	8	16	21	44	0	6	42	5	0	44	9	8	55
3711	300	13	0	32	37	0	10	3	1	16	6	1	28	22
4948	400	17	8	43	29	0	13	24	10	1	28	6	17	49
6185	500	21	16	54	21	0	16	46	6	16	50	11	7	16
7422	600	26	1	5	14	0	20	7	3	2	12	3	26	44
8658	700	0	20	32	3	11	24	22	10	21	45	7	15	31
9895	800	5	4	42	55	11	27	43	7	7	7	0	4	58

Lunations.	Julian Years.	First New Moon. D.	H.	M.	S.	Sun's mean Anomaly. s	°	′	″	M's mean Anomaly. s	°	′	″	Sun from Node. s	°	′	″
11132	900	9	12	53	47	0	1	4		3	22	29		4	24	25	
12369	1000	13	21	4	40	0	4	25		0	7	51		9	13	53	
13606	1100	18	5	15	32	0	7	46		8	23	13		2	3	20	
14843	1200	22	13	26	24	0	11	7		5	8	35		6	22	47	
16080	1300	26	11	37	16	0	14	28		1	23	57		11	12	15	
17316	1400	1	17	4	6	11	18	43		9	13	30		3	1	2	
18553	1500	6	1	14	58	11	22	4		5	28	52		7	20	29	
19790	1600	10	9	25	50	11	25	25		2	14	14		0	9	56	
21027	1700	14	17	36	42	11	28	46		10	29	36		4	29	23	
22264	1800	19	1	47	35	0	2	8		7	14	58		9	18	51	
23501	1900	23	9	58	27	0	5	29		4	0	20		2	8	18	
24738	2000	27	18	9	19	0	8	50		0	15	42		6	27	45	
25974	2100	2	13	36	8	11	13	5		8	5	15		10	16	32	
27211	2200	6	21	47	1	11	16	26		4	20	37		3	6	0	
28448	2300	11	5	57	53	11	19	47		1	5	59		7	25	27	
29685	2400	15	14	8	45	11	23	8		9	21	21		0	14	54	
30922	2500	19	22	19	38	11	26	29		6	6	43		5	4	22	
32159	2600	24	6	30	30	11	29	50		2	22	4		9	23	49	
33396	2700	28	14	41	22	0	3	11		11	7	26		2	13	16	
34632	2800	3	10	8	11	11	7	26		6	26	59		6	2	3	
35869	2900	7	18	19	3	11	10	47		3	12	21		10	21	30	
37106	3000	12	2	29	56	11	14	8		11	27	43		3	10	58	
38343	3100	16	10	40	48	11	17	30		8	13	5		8	0	25	
39580	3200	20	18	51	40	11	20	51		4	28	27		0	19	52	
40817	3300	25	3	2	33	11	24	12		1	13	49		5	9	20	
42054	3400	29	11	13	25	11	27	33		9	29	11		9	28	47	
43290	3500	4	6	40	14	11	1	48		5	18	44		1	17	34	
44527	3600	8	14	51	6	11	5	9		2	4	6		6	7	1	
45764	3700	12	23	1	59	11	8	30		10	19	28		10	26	29	
47001	3800	17	7	12	51	11	11	51		7	4	50		3	15	56	
48238	3900	21	15	23	43	11	15	12		3	20	12		8	5	23	
49475	4000	25	23	34	35	11	18	33		0	5	34		0	24	50	
50711	4100	0	19	1	25	10	22	48		7	25	7		4	13	37	
51948	4200	5	3	12	17	10	26	9		4	10	29		9	3	5	
53185	4300	9	11	23	9	10	29	31		0	25	51		1	22	32	
54422	4400	13	19	34	1	11	2	52		9	11	13		6	11	59	
55659	4500	18	3	44	54	11	6	13		5	26	35		11	1	27	
56896	4600	22	11	55	46	11	9	34		2	11	57		3	20	54	
58133	4700	26	20	6	38	11	12	55		10	27	19		8	10	21	
59369	4800	1	15	33	27	10	17	9		6	16	52		11	29	8	
60606	4900	5	23	44	20	10	20	31		3	2	14		4	18	36	
61843	5000	10	7	55	12	10	23	52		11	17	36		9	8	3	
63080	5100	14	16	6	4	10	27	13		8	2	58		1	27	30	
64317	5200	19	0	16	56	11	0	34		4	18	20		6	16	57	
65554	5300	23	8	27	49	11	3	55		1	3	42		11	6	25	
65791	5400	27	16	38	41	11	7	16		9	19	4		2	25	52	
68028	5500	2	12	5	30	10	11	31		5	8	37		7	14	39	
69265	5600	6	20	16	22	10	14	52		1	23	59		0	4	6	
70502	5700	11	4	27	15	10	18	14		10	9	21		4	23	34	
71739	5800	15	12	38	7	10	21	35		6	24	43		9	13	1	
72976	5900	19	20	48	59	10	24	56		3	10	5		2	2	28	
74212	6000	24	4	59	52	10	28	17		11	25	27		6	21	56	

TABLE VII. *The annual, or first Equation of the mean to the true Syzygy.*

Argument. Sun's mean Anomaly.

Subtract.

Degrees	0 Signs H. M. S.	1 Sign H. M. S.	2 Signs H. M. S.	3 Signs H. M. S.	4 Signs H. M. S.	5 Signs H. M. S.	Degrees
0	0 0 0	2 3 12	3 35 0	4 10 53	3 39 30	2 7 45	30
1	0 4 18	2 6 55	3 37 10	4 10 57	3 37 19	2 3 55	29
2	0 8 35	2 10 36	3 39 18	4 10 55	3 35 6	2 0 1	28
3	0 12 51	2 14 15	3 41 23	4 10 49	3 32 50	1 56 5	27
4	0 17 8	2 17 52	3 43 26	4 10 39	3 30 30	1 52 6	26
5	0 21 24	2 21 27	3 45 25	4 10 24	3 28 5	1 48 4	25
6	0 25 39	2 25 9	3 47 19	4 10 4	3 25 35	1 41 1	24
7	0 28 55	2 28 29	3 49 7	4 9 39	3 23 0	1 39 56	23
8	0 34 11	2 31 57	3 50 50	4 9 10	3 20 20	1 35 49	22
9	0 38 26	2 35 22	3 52 29	4 8 37	3 17 35	1 31 41	21
10	0 42 39	2 38 44	3 54 4	4 7 59	3 14 49	1 27 31	20
11	0 46 52	2 42 3	3 55 35	4 7 16	3 11 59	1 23 19	19
12	0 51 4	2 45 18	3 57 2	4 6 29	3 9 6	1 19 5	18
13	0 55 17	2 48 30	3 58 27	4 5 37	3 6 10	1 14 49	17
14	0 59 27	2 51 40	3 59 49	4 4 41	3 3 10	1 10 32	16
15	1 3 36	2 54 48	3 1 7	4 3 40	3 0 7	1 6 15	15
16	1 7 45	2 57 53	4 2 18	4 2 35	2 57 0	1 1 56	14
17	1 11 53	3 0 54	4 3 23	4 1 26	2 53 49	0 57 36	13
18	1 16 0	3 3 51	4 4 22	4 0 12	2 50 36	0 53 15	12
19	1 20 6	3 6 45	4 5 18	3 58 52	2 47 18	0 48 52	11
20	1 24 10	3 9 36	4 6 10	3 57 27	2 43 57	0 44 28	10
21	1 28 12	3 12 24	4 6 58	3 55 59	2 40 33	0 40 2	9
22	1 32 12	3 15 9	4 7 41	3 54 26	2 37 6	0 35 36	8
23	1 36 10	3 17 51	4 8 21	3 52 49	2 33 35	0 31 10	7
24	1 40 6	3 20 30	4 8 57	3 51 9	2 30 2	0 26 44	6
25	1 44 1	3 23 5	4 9 29	3 49 26	2 26 26	0 22 17	5
26	1 47 54	3 25 36	4 9 55	3 47 38	2 22 47	0 17 50	4
27	1 51 46	3 28 3	4 10 16	3 45 44	2 19 5	0 13 23	3
28	1 55 37	3 30 26	4 10 33	3 43 45	2 15 20	0 8 56	2
29	1 59 26	3 32 45	4 10 45	3 41 40	2 11 35	0 4 29	1
30	2 3 12	3 35 0	4 10 53	3 39 30	2 7 45	0 0 0	0
Deg.	11 Signs	10 Signs	9 Signs	8 Signs	7 Signs	6 Signs	Deg.

Add

TABLE VIII. *Equation of the Moon's mean Anomaly.*

Argument. Sun's mean Anomaly.

Subtract.

Degrees	0 Signs ° ′ ″	1 Sign ° ′ ″	2 Signs ° ′ ″	3 Signs ° ′ ″	4 Signs ° ′ ″	5 Signs ° ′ ″	Degrees
0	0 0 0	0 46 45	1 21 32	1 35 1	1 23 4	0 48 19	30
1	0 1 37	0 48 10	1 22 21	1 35 2	1 22 14	0 46 51	29
2	0 3 13	0 49 34	1 23 10	1 35 1	1 21 24	0 45 23	28
3	0 4 52	0 50 53	1 23 57	1 35 0	1 20 32	0 43 54	27
4	0 6 28	0 52 19	1 24 41	1 34 57	1 19 38	0 42 24	26
5	0 8 6	0 53 40	1 25 24	1 34 50	1 18 42	0 40 53	25
6	0 9 42	0 55 0	1 26 6	1 34 43	1 17 45	0 39 21	24
7	0 11 20	0 56 21	1 26 48	1 34 33	1 16 48	0 37 49	23
8	0 12 56	0 57 38	1 27 28	1 34 22	1 15 47	0 36 15	22
9	0 14 33	0 58 56	1 28 6	1 34 9	1 14 44	0 34 40	21
10	0 16 10	1 0 13	1 28 43	1 33 53	1 13 41	0 33 5	20
11	0 17 47	1 1 29	1 29 17	1 33 37	1 12 37	0 31 31	19
12	0 19 23	1 2 43	1 29 51	1 33 20	1 11 33	0 29 54	18
13	0 20 59	1 3 56	1 30 22	1 33 0	1 10 26	0 28 18	17
14	0 22 35	1 5 8	1 30 50	1 32 38	1 9 17	0 26 40	16
15	0 24 10	1 6 18	1 31 19	1 32 14	1 8 8	0 25 3	15
16	0 25 45	1 7 27	1 31 45	1 31 50	1 6 58	0 23 23	14
17	0 27 19	1 8 36	1 32 12	1 31 23	1 5 46	0 21 45	13
18	0 28 52	1 9 42	1 32 34	1 30 55	1 4 32	0 20 7	12
19	0 30 25	1 10 49	1 32 57	1 30 25	1 3 19	0 18 28	11
20	0 31 57	1 11 54	1 33 17	1 29 54	1 2 1	0 16 48	10
21	0 33 29	1 12 58	1 33 36	1 29 20	1 0 45	0 15 8	9
22	0 35 2	1 14 1	1 33 52	1 28 45	0 59 26	0 13 28	8
23	0 36 32	1 15 1	1 34 6	1 28 9	0 58 7	0 11 48	7
24	0 38 1	1 16 0	1 34 18	1 27 30	0 56 45	0 10 7	6
25	0 39 29	1 16 59	1 34 30	1 26 50	0 55 23	0 8 20	5
26	0 40 59	1 17 57	1 34 40	1 26 27	0 54 1	0 6 44	4
27	0 42 26	1 18 52	1 34 48	1 25 5	0 52 37	0 5 3	3
28	0 43 54	1 19 47	1 34 54	1 24 39	0 51 12	0 3 21	2
29	0 45 19	1 20 40	1 34 58	1 23 52	0 49 45	0 1 40	1
30	0 46 45	1 21 32	1 35 1	1 23 4	0 48 19	0 0 0	0
Deg.	11 Signs	10 Signs	9 Signs	8 Signs	7 Signs	6 Signs	Deg.

TAB. IX. *The second Equation of the mean to the true Sizygy.*

Argument. Moon's equated Anomaly.

Add

Degrees	0 Signs H. M. S.	1 Sign H. M. S.	2 Sign H. M. S.	3 Signs H. M. S.	4 Signs H. M. S.	5 Signs H. M. S.	Degrees
0	0 0 0	5 12 48	8 47 8	9 46 44	8 8 59	4 34 33	30
1	0 10 58	5 21 56	8 51 45	9 45 3	8 3 12	4 26 1	29
2	0 21 56	5 30 57	8 56 10	9 45 12	7 57 23	4 17 25	28
3	0 32 54	5 39 51	9 0 25	9 44 11	7 51 33	4 8 47	27
4	0 43 52	5 48 37	9 4 31	9 42 59	7 45 46	4 0 7	26
5	0 54 50	5 57 17	9 8 25	9 41 36	7 39 46	3 51 23	25
6	1 5 48	6 5 51	9 12 9	9 40 3	7 33 36	3 42 32	24
7	1 16 46	6 14 19	9 15 43	9 38 19	7 27 22	3 33 38	23
8	1 27 44	6 22 41	9 19 5	9 36 24	7 21 2	3 24 42	22
9	1 38 40	6 30 57	9 22 14	9 34 18	7 14 30	3 15 44	21
10	1 49 33	6 39 4	9 25 12	9 32 1	7 7 50	3 6 45	20
11	2 0 23	6 47 0	9 27 54	9 29 33	7 1 2	2 57 43	19
12	2 11 10	6 54 46	9 30 32	9 26 54	6 54 8	2 48 39	18
13	2 21 54	7 2 24	9 32 58	9 24 4	6 47 9	2 39 34	17
14	2 32 34	7 9 52	9 35 12	9 21 3	6 40 6	2 30 28	16
15	2 43 9	7 17 9	9 37 14	9 17 51	6 32 56	2 21 19	15

TABLE IX. *Concluded.*

Degrees	0 Signs H.	M.	S.	1 Sign H.	M.	S.	2 Signs H.	M.	S.	3 Signs H.	M.	S.	4 Signs H.	M.	S.	5 Signs H.	M.	S.	Degrees
0	0	0	0	5	12	48	8	47	8	9	46	44	8	8	59	4	34	33	30
16	2	53	38	7	24	19	9	39	8	9	14	28	6	25	40	2	12	8	14
17	3	4	3	7	31	18	9	40	51	9	10	54	6	18	18	2	2	53	13
18	3	14	24	7	38	9	9	42	21	9	7	9	6	10	49	1	53	36	12
19	3	24	42	7	44	51	9	43	42	9	3	13	6	3	16	1	44	16	11
20	3	34	58	7	51	24	9	44	53	8	59	6	5	55	38	1	34	54	10
21	3	45	11	7	57	45	9	45	52	8	54	50	5	47	54	1	25	31	9
22	3	55	21	8	3	56	9	46	38	8	50	24	5	40	4	1	16	7	8
23	4	5	26	8	9	57	9	47	13	8	45	48	5	32	9	1	6	41	7
24	4	15	26	8	15	46	9	47	36	8	41	2	5	24	9	0	57	13	6
25	4	25	20	8	21	24	9	47	49	8	36	6	5	16	5	0	47	44	5
26	4	35	6	8	26	53	9	47	54	8	31	0	5	7	56	0	38	13	4
27	4	44	42	8	32	11	9	47	46	8	25	44	4	59	42	0	28	41	3
28	4	54	11	8	37	19	9	47	33	8	20	18	4	51	15	0	19	8	2
29	5	3	33	8	42	18	9	47	14	8	14	33	4	43	2	0	9	34	1
30	5	12	48	8	47	8	9	46	44	8	8	59	4	34	33	0	0	0	0
Deg.	11 Signs			10 Signs			9 Signs			8 Signs			7 Signs			6 Signs			Deg.

TAB. X. *The third equation of the mean to the true Syzygy.*

Argument. Sun's Anomaly.—Moon's Anomaly.

Degrees	Signs 0 / 6 Sub. Add M.	S.	Signs 1 / 7 Sub. Add M.	S.	Signs 2 / 8 Sub. Add M.	S.	Degrees
0	0	0	2	22	4	12	30
1	0	5	2	26	4	15	29
2	0	10	2	30	4	18	28
3	0	15	2	34	4	21	27
4	0	20	2	38	4	24	26
5	0	25	2	42	4	27	25
6	0	30	2	46	4	30	24
7	0	35	2	50	4	32	23
8	0	40	2	54	4	34	22
9	0	45	2	58	4	36	21
10	0	50	3	2	4	38	20
11	0	55	3	6	4	40	19
12	1	0	3	10	4	42	18
13	1	5	3	14	4	44	17
14	1	10	3	18	4	46	16
15	1	15	3	22	4	48	15
16	1	20	3	26	4	50	14
17	1	25	3	30	4	51	13
18	1	30	3	34	4	52	12
19	1	35	3	38	4	53	11
20	1	40	3	42	4	54	10
21	1	45	3	45	4	55	9
22	1	49	3	48	4	56	8
23	1	52	3	51	4	57	7
24	1	56	3	54	4	57	6
25	2	0	3	57	4	57	5
26	2	4	4	0	4	58	4
27	2	9	4	3	4	58	3
28	2	13	4	6	4	58	2
29	2	18	4	9	4	59	1
30	2	22	4	12	4	58	0
Degrees	Signs 5 / 11 Sub. Add		Signs 4 / 10 Sub Add		Signs 3 / 9 Sub. Add		Degrees

TAB. XI. *The fourth equation of the mean to the true Syzygy.*

Argument Sun's mean diſtance from the Node.

Add

Degrees	0 / 6 Sig. M.	S.	1 / 7 Sig. M.	S.	2 / 8 Sig. M.	S.	Degrees
0	0	0	1	22	1	22	30
1	0	4	1	23	1	21	29
2	0	7	1	24	1	20	28
3	0	10	1	25	1	18	27
4	0	13	1	26	1	16	26
5	0	16	1	27	1	14	25
6	0	20	1	28	1	12	24
7	0	23	1	29	1	10	23
8	0	26	1	30	1	8	22
9	0	29	1	31	1	6	21
10	0	32	1	32	1	3	20
11	0	35	1	33	1	0	19
12	0	38	1	33	0	57	18
13	0	41	1	34	0	54	17
14	0	44	1	34	0	51	16
15	0	47	1	34	0	49	15
16	0	50	1	34	0	45	14
17	0	52	1	34	0	41	13
18	0	54	1	34	0	37	12
19	0	57	1	33	0	34	11
20	1	0	1	33	0	31	10
21	1	2	1	32	0	28	9
22	1	5	1	31	0	25	8
23	1	8	1	30	0	22	7
24	1	10	1	29	0	19	6
25	1	12	1	28	0	16	5
26	1	14	1	27	0	13	4
27	1	16	1	26	0	10	3
28	1	18	1	25	0	6	2
29	1	20	1	24	0	3	1
30	1	22	1	22	0	0	0
Deg.	5 / 11 Sig.		4 / 10 Sig.		3 / 9 Sig.		Deg.

Subtract

TABLE XII. *The Sun's mean Longitude, Motion, and Anomaly: Old Style.*

Years beginning	Sun's mean Longitude. s	°	′	″	Sun's mean Anomaly. s	°	′
1	9	7	53	10	6	28	48
201	9	9	23	50	6	26	57
301	9	10	9	10	6	26	1
401	9	10	54	30	6	25	5
501	9	11	39	50	6	24	9
1001	9	15	26	30	6	19	32
1101	9	16	11	50	6	18	36
1201	9	16	57	10	6	17	40
1301	9	17	42	30	6	16	44
1401	9	18	27	50	6	15	49
1501	9	19	13	10	6	14	53
1601	9	19	58	30	6	13	57
1701	9	20	43	50	6	13	1
1801	9	21	29	10	6	12	6

Years complete	Sun's mean Motion. s	°	′	″	Sun's mean Anomaly. s	°	′
1	11	29	45	40	11	29	45
2	11	29	31	20	11	29	29
3	11	29	17	0	11	29	14
4	0	0	1	49	11	29	58
5	11	29	47	29	11	29	42
6	11	29	33	9	11	29	27
7	11	29	18	49	11	29	11
8	0	0	3	38	11	29	55
9	11	29	49	18	11	29	40
10	11	29	34	58	11	29	24
11	11	29	20	38	11	29	9
12	0	0	5	26	11	29	53
13	11	29	51	7	11	29	37
14	11	29	36	47	11	29	22
15	11	29	22	27	11	29	7
16	0	0	7	15	11	29	50
17	11	29	52	55	11	29	35
18	11	29	38	35	11	29	20
19	11	29	24	16	11	29	4
20	0	0	9	4	11	29	48
40	0	0	18	8	11	29	37
60	0	0	27	12	11	29	26
80	0	0	36	16	11	29	15
100	0	0	45	20	11	29	4
200	0	1	30	40	11	28	8
300	0	2	16	0	11	27	12
400	0	3	1	20	11	26	16
500	0	3	46	40	11	25	21
600	0	4	32	0	11	24	25
700	0	5	17	20	11	23	29
800	0	6	2	40	11	22	33
900	0	6	48	0	11	21	37
1000	0	7	33	20	11	20	41
2000	0	15	6	40	11	11	22
3000	0	22	40	0	11	2	3
4000	1	0	13	20	10	22	44
5000	1	7	46	40	10	13	25
6000	1	15	20	0	10	4	6

Months	Sun's mean Motion. s	°	′	″	Sun's mean Anomaly. s	°	′
Jan.	0	0	0	0	0	0	0
Feb.	1	0	33	18	1	0	33
Mar.	1	28	9	11	1	28	9
Apr.	2	28	42	30	2	28	42
May	3	28	16	40	3	28	17
June	4	28	49	58	4	28	50
July	5	28	24	8	5	28	24
Aug.	6	28	57	26	6	28	57
Sept.	7	29	30	44	7	29	30
Oct.	8	29	4	54	8	29	4
Nov.	9	29	38	12	9	29	37
Dec.	10	29	12	22	10	29	11

Days	Sun's mean Motion and Anomaly. s	°	′	″	H / M / S	Sun's mean Motion and Anomaly. ° / ′ / ″	′ / ″ / ‴	″ / ‴ / ⁗	Sun's mean diſt. from the Node. ° / ′ / ″	′ / ″ / ‴	″ / ‴ / ⁗	H / M / S	Sun's mean Motion and Anomaly. ° / ′ / ″	′ / ″ / ‴	″ / ‴ / ⁗	Sun's mean diſt. from the Node. ° / ′ / ″	′ / ″ / ‴	″ / ‴ / ⁗
1	0	0	59	8														
2	0	1	58	17	1	0	2	28	0	2	36	31	1	16	23	1	20	30
3	0	2	57	25	2	0	4	56	0	5	12	32	1	18	51	1	23	6
4	0	3	56	33	3	0	7	24	0	7	48	33	1	21	19	1	25	42
5	0	4	55	42	4	0	9	51	0	10	23	34	1	23	47	1	28	18
6	0	5	54	50	5	0	12	19	0	12	59	35	1	26	15	1	30	54
7	0	6	53	58	6	0	14	47	0	15	35	36	1	28	42	1	33	29
8	0	7	53	7	7	0	17	15	0	18	11	37	1	31	10	1	36	5
9	0	8	52	15	8	0	19	43	0	20	47	38	1	33	38	1	38	40
10	0	9	51	23	9	0	22	11	0	23	23	39	1	36	6	1	41	16
11	0	10	50	32	10	0	24	38	0	25	58	40	1	38	34	1	43	52
12	0	11	49	40	11	0	27	6	0	28	34	41	1	41	2	1	46	28
13	0	12	48	48	12	0	29	34	0	31	10	42	1	43	30	1	49	4
14	0	13	47	57	13	0	32	2	0	33	45	43	1	45	57	1	51	39
15	0	14	47	5	14	0	34	30	0	36	21	44	1	48	25	1	54	15
16	0	15	46	13	15	0	36	58	0	38	57	45	1	50	53	1	55	51
17	0	16	45	22	16	0	39	26	0	41	33	46	1	53	21	1	59	27
18	0	17	44	30	17	0	41	53	0	44	8	37	1	55	49	2	2	3
19	0	18	43	38	18	0	44	21	0	46	44	48	1	58	17	2	4	39
20	0	19	42	47	19	0	46	49	0	49	20	49	2	0	44	2	7	13
21	0	20	41	55	20	0	49	17	0	51	56	50	2	3	12	2	9	50
22	0	21	41	3	21	0	51	45	0	54	32	51	2	5	40	2	12	25
23	0	22	40	12	22	0	54	13	0	57	8	52	2	8	8	2	15	2
24	0	23	39	20	23	0	56	40	0	59	43	53	2	10	36	2	17	38
25	0	24	38	28	24	0	59	8	1	2	19	54	2	13	4	2	20	14
26	0	25	37	37	25	1	1	36	1	4	55	55	2	15	32	2	22	50
27	0	26	36	45	26	1	4	4	1	7	31	56	2	17	59	2	25	26
28	0	27	35	53	27	1	6	32	1	10	7	57	2	20	27	2	28	2
29	0	28	35	2	28	1	9	0	1	12	43	58	2	22	55	2	30	28
30	0	29	34	10	29	1	11	28	1	15	19	59	2	25	23	2	33	14

TABLE XIII. *Equation of the Sun's centre, or the difference between his mean and true place.*

Argument. Sun's mean Anomaly.

Subtract.

Degrees	0 Signs °	′	″	1 Sign °	′	″	2 Signs °	′	″	3 Signs °	′	″	4 Signs °	′	″	5 Signs °	′	″	Degrees
0	0	0	0	0	56	47	1	39	6	1	55	37	1	41	12	0	58	33	30
1	0	1	59	0	58	30	1	40	7	1	55	39	1	40	12	0	57	7	29
2	0	3	57	1	0	12	1	41	6	1	55	38	1	39	10	0	55	19	28
3	0	5	56	1	1	53	1	42	3	1	55	36	1	38	6	0	53	30	27
4	0	7	54	1	3	33	1	42	59	1	55	31	1	37	0	0	51	40	26
5	0	9	52	1	5	12	1	43	52	1	55	24	1	35	52	0	49	49	25
6	0	11	50	1	6	50	1	44	44	1	55	15	1	34	43	0	47	57	24
7	0	13	48	1	8	27	1	45	34	1	55	3	1	33	32	0	46	5	23
8	0	15	46	1	10	2	1	46	22	1	54	50	1	32	19	0	44	11	22
9	0	17	43	1	11	36	1	47	8	1	54	35	1	31	4	0	42	16	21
10	0	19	40	1	13	9	1	47	52	1	54	17	1	29	47	0	40	21	20
11	0	21	37	1	14	41	1	48	35	1	53	57	1	28	29	0	38	25	19
12	0	23	33	1	16	11	1	49	15	1	53	36	1	27	9	0	36	28	18
13	0	25	29	1	17	40	1	49	54	1	53	12	1	25	48	0	34	30	17
14	0	27	25	1	19	8	1	50	30	1	52	46	1	24	25	0	32	32	16
15	0	29	20	1	20	34	1	51	5	1	52	18	1	23	0	0	30	33	15
16	0	31	15	1	21	59	1	51	37	1	51	48	1	21	34	0	28	33	14
17	0	33	9	1	23	22	1	52	8	1	51	15	1	20	6	0	26	33	13
18	0	35	2	1	24	44	1	52	36	1	50	40	1	18	36	0	24	33	12
19	0	36	55	1	26	5	1	53	3	1	50	5	1	17	5	0	22	32	11
20	0	38	47	1	27	24	1	53	27	1	49	26	1	15	33	0	20	30	10
21	0	40	39	1	28	41	1	53	50	1	48	46	1	13	59	0	18	28	9
22	0	42	30	1	29	57	1	54	10	1	48	3	1	12	24	0	16	26	8
23	0	44	20	1	31	11	1	54	28	1	47	19	1	10	47	0	14	24	7
24	0	46	9	1	32	25	1	54	44	1	46	32	1	9	9	0	12	21	6
25	0	47	57	1	33	35	1	54	58	1	45	44	1	7	29	0	10	18	5
26	0	49	45	1	34	45	1	55	10	1	44	53	1	5	49	0	8	14	4
27	0	51	32	1	35	53	1	55	20	1	44	1	1	4	7	0	6	11	3
28	0	53	18	1	36	59	1	55	28	1	43	7	1	2	24	0	4	7	2
29	0	55	3	1	38	3	1	55	34	1	42	10	1	0	39	0	2	4	1
30	0	56	47	1	39	6	1	55	37	1	41	12	0	58	52	0	0	0	0
Deg.	11 Signs			10 Signs			9 Signs			8 Signs			7 Signs			6 Signs			Deg.

Add

TABLE XIV. *The Sun's Declination.*

Argument. Sun's true place.

Degrees	Signs 0 N. 6 S. °	′	Signs 1 N. 7 S. °	′	Signs 2 N. 8 S. °	′	Degrees	Degrees	Signs 0 N. 6 S. °	′	Signs 1 N. 7 S. °	′	Signs 2 N. 8 S. °	′	Degrees
0	0	0	11	30	20	11	30	30	0	0	11	30	20	11	20
1	0	24	11	51	20	24	29	16	6	18	16	39	22	45	14
2	0	48	12	11	20	36	28	17	6	41	16	57	22	51	13
3	1	12	12	32	20	48	27	18	7	4	17	14	22	56	12
4	1	36	12	53	20	59	26	19	7	27	17	30	23	2	11
5	1	59	13	13	21	10	25	20	7	50	17	46	23	6	19
6	2	23	13	33	21	21	24	21	8	12	18	2	23	11	9
7	2	47	13	53	21	31	23	22	8	35	18	18	23	14	8
8	3	11	14	12	21	41	22	23	9	57	18	32	23	18	7
9	3	34	14	31	21	50	21	24	9	20	18	42	23	21	6
10	3	58	14	50	21	59	20	25	9	42	19	[illegible]	23	[illegible]	5
11	4	22	15	9	22	8	19	26	10	4	19	17	23	25	4
12	4	45	15	29	22	16	18	27	10	25	19	31	23	27	3
13	5	9	15	46	22	24	17	28	10	47	19	45	23	28	2
14	5	32	16	4	22	31	16	29	11	8	19	58	23	29	1
15	5	5	16	22	22	39	15	30	11	30	20	11	23	29	0
Degrees	Signs 11 S. 5 N.		Signs 10 S. 4 N.		Signs 9 S. 3 N.		Degrees	Degrees	Signs 11 S. 5 N.		Signs 10 S. 4 N.		Signs 9 S. 3 N.		Degrees

TABLE XV. *Equation of the Sun's mean Distance from the Node.*

Argument. Sun's mean Anomaly.

Subtract.

Deg.	0 Signs °	′	1 Sign °	′	2 Signs °	′	3 Signs °	′	4 Signs °	′	5 Signs °	′	Deg.	Deg.	0 Signs °	′	1 Sign °	′	2 Signs °	′	3 Signs °	′	4 Signs °	′	5 Signs °	′	Deg.
0	0	0	1	2	1	47	2	5	1	50	1	4	30	0	0	0	1	2	1	47	2	5	1	50	1	4	30
1	0	2	1	4	1	48	2	5	1	48	1	2	29	16	0	34	1	28	2	1	2	1	1	28	0	31	14
2	0	4	1	6	1	49	2	5	1	47	1	0	28	17	0	36	1	30	2	1	2	1	1	27	0	29	13
3	0	6	1	8	1	50	2	5	1	46	0	58	27	18	0	38	1	31	2	2	2	0	1	25	0	27	12
4	0	9	1	10	1	51	2	5	1	45	0	56	26	19	0	40	1	34	2	2	2	0	1	24	0	24	11
5	0	11	1	12	1	52	2	5	1	44	0	54	25	20	0	42	1	35	2	3	1	59	1	23	0	22	10
6	0	13	1	14	1	53	2	5	1	43	0	52	24	21	0	44	1	36	2	3	1	59	1	21	0	20	9
7	0	15	1	16	1	54	2	4	1	41	0	50	23	22	0	46	1	37	2	4	1	58	1	19	0	18	8
8	0	17	1	17	1	55	2	4	1	40	0	48	22	23	0	48	1	39	2	4	1	57	1	17	0	16	7
9	0	19	1	18	1	56	2	4	1	39	0	46	21	24	0	50	1	40	2	4	1	56	1	15	0	13	6
10	0	21	1	19	1	57	2	4	1	37	0	44	20	25	0	52	1	41	2	4	1	55	1	13	0	11	5
11	0	23	1	21	1	58	2	3	1	36	0	42	19	26	0	54	1	43	2	5	1	54	1	11	0	9	4
12	0	25	1	22	1	58	2	3	1	34	0	40	18	27	0	56	1	44	2	5	1	53	1	9	0	7	3
13	0	28	1	24	1	59	2	3	1	33	0	37	17	27	0	58	1	45	2	5	1	52	1	8	0	5	2
14	0	30	1	26	2	0	2	2	1	31	0	35	16	29	1	0	1	46	2	5	1	51	1	6	0	3	1
15	0	32	1	27	2	0	2	2	1	30	0	33	15	30	1	2	1	47	2	5	1	50	1	5	0	0	0
Deg.	11 Signs		10 Signs		9 Signs		8 Signs		7 Signs		6 Signs		Deg.	Deg.	11 Signs		10 Signs		9 Signs		8 Signs		7 Signs		6 Signs		Deg.

Add

TABLE XVI. *The Moon's Latitude in Ecliptic.*

Arg. Moon's equated Distance from the Node.

0 Signs. *North Ascend.*

6 Signs. *South Descend.*

°	°	′	″	°
0	0	0	0	30
1	0	5	15	29
2	0	10	30	28
3	0	15	45	27
4	0	20	59	26
5	0	26	13	25
6	0	31	26	24
7	0	36	39	23
8	0	41	51	22
9	0	47	2	21
10	0	52	13	20
11	0	57	23	19
12	1	2	31	18
13	1	7	38	17
14	1	12	44	16
15	1	17	49	15
16	1	22	52	14
17	1	27	53	13
18	1	32	52	12
19	1	37	49	11

5 Signs. *North Descend.*

11 Signs. *South Ascend.*

This Table shows the Moon's Latitude a little beyond the utmost Limits of Escliplses.

TABLE XVII. *The Moon's horizontal Parallax, with the Semi-diameters and true Horary Motions of the Sun and Moon, to every sixth degree of their mean Anomalies, the quantities for the intermediate degrees being easily proportioned by sight.*

Anomaly of Sun and Moon. s	°	Moon's horizontal Parallax. ′	″	Sun's Semidiameter. ′	″	Moon's Semidiameter. ′	″	Moon's Horary Motion. ′	″	Sun's Horary Motion. ′	″	Anomaly of Sun and Moon. s	°
0	0	54	29	15	50	14	54	30	10	2	23	12	0
	6	54	31	15	50	14	55	30	12	2	23		24
	12	54	34	15	50	14	56	30	15	2	23		18
	18	54	40	15	51	14	57	30	19	2	23		12
	24	54	47	15	51	14	58	30	26	2	23		6
1	0	54	56	15	52	14	59	30	34	2	24	11	0
	6	55	6	15	53	15	1	30	44	2	24		24
	12	55	17	15	54	15	4	30	55	2	24		18
	18	55	29	15	55	15	8	31	9	2	24		12
	24	55	42	15	56	15	12	31	23	2	25		6
2	0	55	56	15	58	15	17	31	40	2	25	10	0
	6	56	12	15	59	15	22	31	56	2	26		24
	12	56	29	16	1	15	26	32	17	2	27		18
	18	56	48	16	2	15	30	32	39	2	27		12
	24	57	8	16	4	15	36	33	11	2	28		6
3	0	57	30	16	6	15	41	33	23	2	28	9	0
	6	57	52	16	8	15	46	33	47	2	29		24
	12	58	12	16	10	15	52	34	11	2	29		18
	18	58	31	16	11	15	58	34	34	2	29		12
	24	58	49	16	13	16	3	34	58	2	30		6
4	0	59	6	16	14	16	9	35	22	2	30	8	0
	6	59	21	16	15	16	14	35	45	2	31		24
	12	59	35	16	17	16	19	36	0	2	31		18
	18	59	48	16	19	16	24	36	20	2	32		12
	24	60	0	16	20	16	28	36	40	2	32		6
5	0	60	11	16	21	16	31	37	0	2	32	7	0
	6	60	21	16	21	16	32	37	10	2	33		24
	12	60	30	16	22	16	37	37	19	2	33		18
	18	60	38	16	22	16	38	37	28	2	33		12
	24	60	45	16	22	16	39	37	36	2	33		6
6	0	60	45	16	22	16	39	37	40	2	33	6	0

Fig. 205.

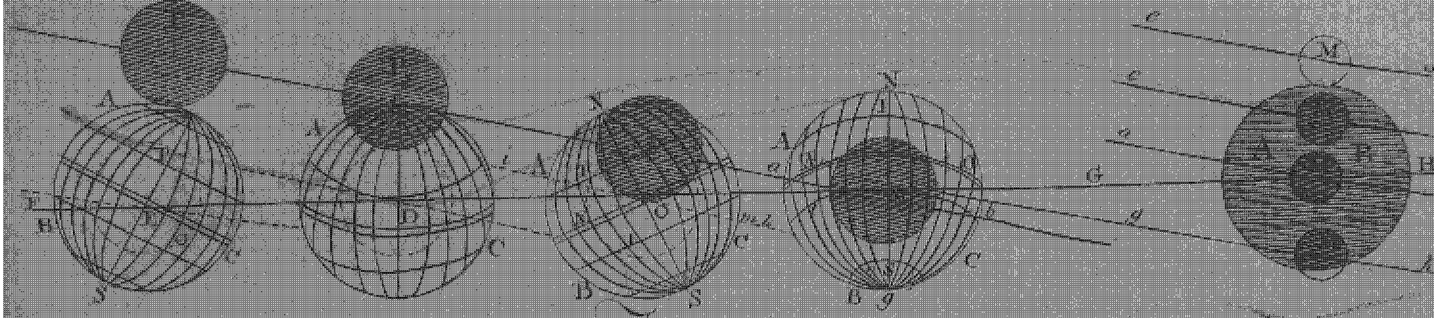
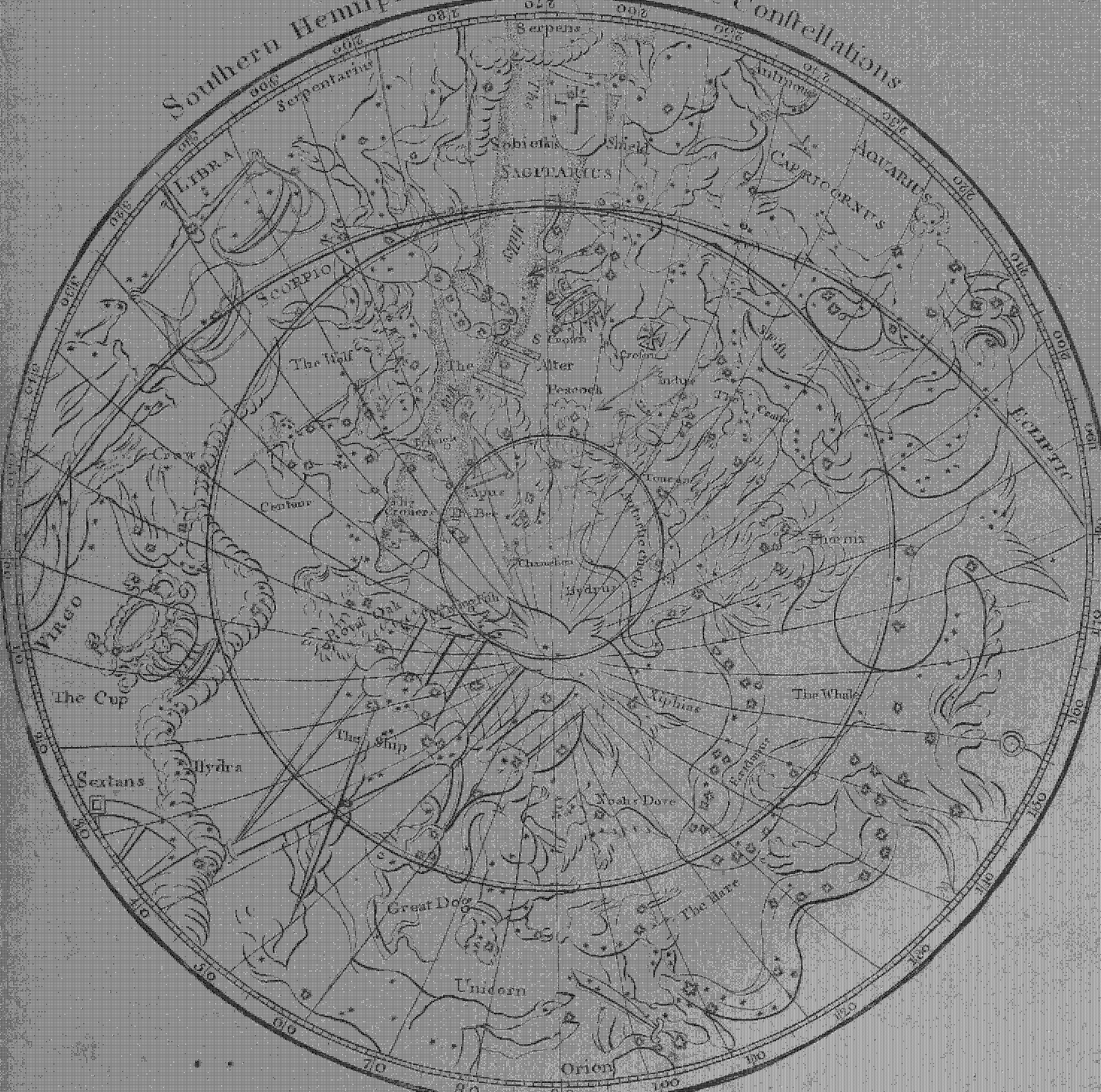


Fig. 206

Southern Hemisphere with the Figures of the Constellations



EXPLANATION AND USE OF THE SOLAR AND LUNAR TABLES.

USE *of the* TABLES *of the* EQUATION *of* TIME.

PROBLEM I.

To convert apparent time into mean time, and the contrary.

SINCE the place of the Sun's apogee does not remain fixed in the ſame point of the ecliptic, but goes forward 1′ 6″ every year, and conſequently about a degree in 55 years, the ſame equation of time will not ſerve accurately for many years continuance. To remedy this defect, we have here given two tables, one adapted to the 16th year of this century, at which time the Sun's apogee was in 8° ♋, the other to the year 1771, when the Sun's apogee was in 9° ♋. Whence the equation of time may be readily found by proportion; and that with ſufficient accuracy, not only for any intermediate year, but alſo for thoſe preceding and following, provided they are not diſtant from theſe above 60 or 100 years. The uſe of tables of this kind is ſo familiar to aſtronomers, that it ſeems unneceſſary to enter into any further explanation of theſe; we ſhall therefore only remark, that the titles of the equation or algebraic ſigns ſtanding over them are what are to be uſed for turning apparent into mean time: but the contrary are to be uſed for turning mean into apparent time.

EXAMPLE.

In the year 1756, April 30, 23ʰ. 20′. 28″, apparent time, the Sun's place was obſerved 1ˢ. 11°. 25′ 8″,6; the equation of time and the mean time are required.

With the given place of the Sun, the equation of time anſwering to the year 1716 is had = — 3′. 18″; and anſwering to the year 1771 = — 3′ 12″; and conſequently to the given year it will be = —3′ 14″; and therefore the mean time is 23ʰ. 17′. 14″.

SCHOLIUM I.

But if the equation of time be required either more accurately or for a time above 100 years diſtant from the limits of the tables, the mean longitude of the Sun muſt be found reckoned from the true equinox, and his true right aſcenſion by Prob. III. and VII. which follow hereafter, and the difference between the two is to be converted into time of the *primum mobile*. And if the right aſcenſion is greater than the mean longitude, the equation ſo found is additive to apparent time, otherwiſe ſubſtractive.

SCHOLIUM II.

I ſay that the true equation of time is to be found by converting the difference abovementioned into time of the *primum mobile*, and not into mean ſolar time. For though the learned De La Caille preſcribes the latter method in his Solar Tables, yet it is eaſy to demonſtrate that the former method is the true one.

USE *of the* CATALOGUE *of* PLACES.

PROBLEM II.

To convert the time of the given place into the time of the meridian of the tables, or the contrary.

THERE is given in a ſelect catalogue the difference in time of the meridians of 60 famous places from the meridian of the tables, marked with the ſign + or —, the firſt of which denotes the place to be weſt of Greenwich, and the latter ſhews it to be eaſt of the ſame. Theſe ſigns are to be uſed if the time of the given place is to be reduced into Greenwich time; but the contrary if Greenwich time is to be reduced into time of the given place.

EXAMPLE.

Let the time at Gottingen be given 6ʰ. 9′. 38″, the time that anſwers to it under the meridian of Greenwich is required?

	h ′ ″
Since the difference in time of the meridians of Gottingen and Greenwich, by catalogue, is	0 . 39 . 32 —
Subtract it, on account of the ſign —, from the given time - - - - -	6 . 9 . 38
The remainder is the Greenwich time required	5 . 30 . 6

SCHOLIUM I.

I deduced the differences aſcribed to the cities of France and the Netherlands from the geometrical meaſure of the French mathematicians, making allowance at the ſame time for the ſpheroidical figure of the earth. The ſituation of the cities in Germany and ſome others I ſettled with particular care from eclipſes of the Sun and occultations of fixed ſtars by the Moon. The reſt I either determined from eclipſes of Jupiter's ſatellites and eclipſes of the Moon, or, where this could not be done, retained them as they are given in the *Connoiſſance des Temps*.

SCHOLIUM II.

In the ſame catalogue are inſerted the latitudes of the places, concerning the uſe of which, as well known, it is ſuperfluous to add any thing. The latitude of Gottingen, as given in the catalogue, is that of the obſervatory of this city; the latitude of Nuremberg is adjuſted to Hoffman's houſe, famous for the ſhop of geographical maps. I deduced both, but particularly that of Gottingen, from my own obſervations. Concerning that of Nuremberg, See Com. Soc. Reg. Gotting. tom. I. p. 373.

USE *and* EXPLANATION *of the* TABLES *of the* MOTION *of the* SUN.

PROBLEM III.

To find the true longitude of the Sun at any aſſigned time by the meridian of the Greenwich obſervatory.

1. FROM the table of epoches, take out the epoches of the mean longitude of the Sun, the apogee, and the numbers I, II, III, IV, for the given year; or, if that is not there to the neareſt year that is ſet down preceding the given year; underneath which place the mean motions anſwering to the number of years elapſed ſince the epoch to the given time.

2. Under theſe write down in order the mean motions for the day of the month, and for the hours, minutes, and ſeconds.

3. Add up the numbers of the ſeveral columns, rejecting 12 S. or any multiple thereof, if they ſhould occur, from the two firſt columns, and rejecting thouſands from num. I, II, III, IV, if they ariſe. And thus the mean longitude of the Sun will be obtained to the aſſigned time in the firſt column, the longitude of the Sun's apogee in the ſecond column, and in the others the numbers proper for finding the corrections ariſing from the actions of the Moon, Jupiter, and Venus.

4. Subſtract the longitude of the apogee from the mean longitude of the Sun, the remainder is the mean anomaly of the Sun.

5. With this anomaly enter the table of the equation of the Sun's centre, and take out the equation of the Sun's centre with its proper ſign, and place it under the Sun's mean longitude.

6. With the numbers I, II, III, IV, enter the tables, and having found the hundreds at the top or bottom, and the tens on the ſide, take out the correction or leſſer equations, each with their proper number reſpectively, without neglecting the proportional part, and let theſe alſo be written under the Sun's mean longitude.

7. Apply theſe equations according to their titles or ſigns to the mean longitude; the reſult is the true longitude of the Sun required.

Example.

If the Sun's true longitude be required to the year 1756, April 30, 23ʰ 17′. 14″, mean time at Greenwich; the calculation performed according to the foregoing precepts will be as follows:

	Mean Long. ☉	Long. ☉'s apog.	N. I.	N. II.	N. III.	N. IV.
	s ° ′ ″	s ° ′ ″				
Epoch of year 1756	9.10.33.18,8	3. 8.44.10	973	262	605	544
Mean Mot. April 30th	3.28.16.39,7	22	64	301	206	18
23ʰ	56.40,5		32	2	2	0
17′	41,9					
14″	0,6					
	1. 9.47.21,5	3. 8.44.32	69	565	813	562
Equat. of cent.	+ 1.37.54,0	Mean an. 10. 1. 2.49				
Equat. ☽ I.	+ 3,4					
♃ II.	— 1,2					
♀ III.	— 0,9					
☊ IV.	— 6,8					
True long. of the Sun.	1.11.25. 9,9					

Scholium I.

The longitude thus found is computed from the true vernal equinoctial point, becaufe of the equation of the equinoxes being applied, which was taken out with number IV. But, in computing the planet's and the moon's place, it is better to make ufe of the Sun's longitude as computed from the mean equinox, till their geocentric longitude is found; in which cafe therefore that equation taken out with number IV. fhould not be applied till then. Thus, in our example, the Sun's longitude reckoned from the mean equinox would be 1ˢ. 11°. 25′. 16″,7.

Scholium II.

When I was conftructing thefe folar tables, I had in my view the tables of that learned aftronomer Lewis de la Caille (who merits much commendation on this fubject) publifhed in the year 1758, and fent me as a prefent from him. Upon examining them I found that they very nearly agreed with the many and careful obfervations made by myfelf from the year 1756 forward with an excellent mural quadrant. Wherefore it did not feem neceffary for me to conftruct folar tables intirely new, but only (availing myfelf of the labours of this illuftrious aftronomer) to correct his tables as far as my obfervations feemed to require. Accordingly I found the excentricity of the Sun's orbit, and confequently the equation of the center, to require no fenfible correction. But, as to the epoches of the mean motion, particularly thofe of the Sun's longitude, I could not make them agree with my obfervations, till I had diminifhed the faid epoch by near feven feconds. Moreover a place of the apogee fomewhat different from his feemed to agree better at leaft with my obfervations, which why I fhould confide lefs in than thofe of others did not appear. Laftly, I had long before deduced from the theory of gravity the difturbances of the apparent motion of the Sun caufed by the Moon, Jupiter and Venus, and found them fuch as are here reprefented, befides fome other fmaller ones, which, being extremely difficult to obferve, I thought might be conveniently neglected in calculation. As to the form of the arguments of thefe fmall corrections, or numbers I, II, III, and IV, I have rendered it more fimple by fuppofing the circle to be divided into 1000 parts.

Scholium III.

I muft not pafs over without mentioning in this place, that all the mean motions both of the Sun and Moon in thefe tables fuppofe the annual motion of the fixed ftars or of the preceffion of the equinoxes to be exactly 50″,3, and to depend thereon fo much, that, if it fhould appear proper to ftate the motion of preceffion flower or quicker, the mean motions of the Sun muft be all made flower or quicker by the fame quantity: and therefore you cannot, without fubverting the whole fabric of the tables, increafe or diminifh one of thefe motions and at the fame time leave the reft unaltered. Thus, for inftance, if the mean motion of the Sun, which I make in 60 Julian years to be 0ˢ. 0°. 27′. 49″,8 over and above the intire revolutions, fhould feem proper to be corrected fo as to agree with the tables of the learned De la Caille, in which that motion is found lefs by 16″,4, this cannot be done except the preceffion of the equinoxes in 60 years, inftead of 50′. 18″ as it is in the tables, be reckoned lefs by the fame quantity or only 50′. 1″,6; and fo much ought the Moon's motion alfo to be corrected. To explain the matter briefly, I would have it obferved, that the mean motions of the Sun and Moon with refpect to the fixed ftars are laid down truly in thefe tables, fo that there fcarce remains a doubt of a few feconds in 60 years; but whether they are alfo laid down juftly with refpect to the equinoctial points muft be judged of from the motion of their preceffion, which being 50′. 18″ in 60 years, according to the opinion of moft modern aftronomers, the affirmative of the queftion cannot be doubted.

Scholium IV.

Whenever therefore any phenomenon is concerned depending on the relative fituation of a fixed ftar and the Sun and Moon; as for inftance, the occulation of a fixed ftar, the motion of preceffion affumed in thefe tables muft be made ufe of in computing the place of the ftar. For this purpofe that motion is added to the mean motion of the Sun, that the calculator may not be left in any uncertainty, nor have any occafion to feek for it elfewhere, or lofe any time in computing it.

Scholium V.

To the fame tables of the mean motions of the Sun, there is alfo added the motion of decreafe of the obliquity of the ecliptic, according to the quantity deduced from the theory of gravity. Hence the mean obliquity of the ecliptic is eafily found to any time, provided it be known for any one year. Now, from my obfervations made with great care with an excellent mural quadrant, at both folftices, in the years 1756, 57, and 58, I find the mean obliquity of the ecliptic to the beginning of the year 1756 to be 23°. 28′. 16″, which therefore fhould be made ufe of in the prefent cafe.

Problem IV.

To find the mean and true obliquity of the ecliptic to any affigned time.

1. From the column that lies fartheft to the right hand, take out the decreafe of the obliquity of the ecliptic, anfwering to the number of years intervening between the given time and the year 1756; which add to 23°. 28′. 16″, if the given time precedes 1756, but fubftract, if it follows the fame, and the mean obliquity

obliquity of the ecliptic will be obtained to the beginning of the year; which is easily reduced to the elapsed time of the given year, by substracting one tenth of a second for every three months.

2. By means of the tables of epoches and mean motions, find num. IV. with which take out the equation from the table intitled Nutation, and apply it according to its sign to the mean obliquity just found, and you have the true or apparent obliquity.

EXAMPLE.

What was the true obliquity of the ecliptic in the beginning of September 1671.

Because from this year to the year 1756 there are elapsed 85 years, the decrease of the obliquity will be found for 80 years - -	36″,8
For 5 years - -	2,3
And consequently for 85 years - -	39,1

Which added to 23°. 28′. 16″,0 gives the mean obliquity of the ecliptic 23°. 28′ 55″,1, and in the month of September 23°. 28′. 54″,8.

Now num. IV. to the epoch 1660 is - - -	386
The motion for 11 years - -	591
For the beginning of September -	36
Therefore num. IV. to the given time, rejecting 1000, is	13

To which the corresponding correction or nutation is +9″,6, which, being added to the mean obliquity 23°. 28′. 54″,8, gives the true obliquity 23°. 29′. 4″,4.

SCHOLIUM I.

But if the mean obliquity is to be found from the true, it is evident that the nutation must be applied with a contrary sign.

SCHOLIUM II.

The maximum of nutation 9″,6, according to which this table is constructed, exceeds a little that which is commonly assumed, the laws of attraction requiring such increase, and the observations at the same time favouring it.

PROBLEM V.

To find the logarithm of the Sun's distance from the earth at any assigned time.

1. If the mean anomaly of the Sun, with the numbers I, II, III, are not already known from a calculation of the Sun's longitude, they must be found by prob. III. 1. 2. 3. 4.

2. With the mean anomaly take out the logarithm of the distance in the ecliptic hypothesis.

3. To this apply the corrections taken with the numbers I. II. III, out of their respective tables, the result is the true logarithm of the distance.

EXAMPLE.

In the example of prob. III. the mean anomaly of the Sun was 10ˢ. 1°. 2′. 49″, wherefore the uncorrected logarithm is - - - -		0.003836
Num. I. 69. gives - - - -	+	15
Num. II. 565. - - - -	—	8
Num. III. 813. - - - -	—	5
Therefore the logarithm of the true distance		0.003838

SCHOLIUM.

These logarithms are adapted to a mean distance = 1, wherefore to prevent the logarithms of numbers less than unity from coming out negative, their index is supposed to be increased by ten, which therefore must be again rejected, when the case requires it.

PROBLEM VI.

To find the apparent semidiameter, and also the hourly motion of the Sun, to any assigned time.

Both are readily had, if the mean anomaly of the Sun to the given time be known or first found by prob. III.

EXAMPLE.

In the example of prob. III. the mean anomaly of the Sun was - - - -	° ′ ″ 10. 1. 2. 49
Wherefore the apparent semidiameter of the Sun is	15. 54,3
And his true hourly motion - -	2. 25,2

SCHOLIUM.

The semidiameter of the Sun, as here given, is suited to the supposition of the semidiameter at the mean distance being 16′. 2″,8; which quantity I have inferred from above 130 observations made with the mural quadrant, which did not seem ill-adapted for this purpose.

PROBLEM VII.

The longitude of the Sun or any point of the ecliptic, and the obliquity of the ecliptic being given, to find the corresponding right ascension.

1. With the given longitude look for the reduction and its mutation or change.

2. Say, as 60″ : is to this mutation : : so is the difference between 23°. 28′. 15″,0 and the given obliquity, to a fourth number, which added to the reduction just found, if the given obliquity be greater than 23°. 28′. 15″,0, or substracted from it, if the obliquity be less, will give the reduction corrected.

3. Therefore apply this according to its sign to the longitude, and you will have the right ascension required.

EXAMPLE.

Let the longitude of the Sun be given 1ˢ. 11°. 25′. 10″,3, and the obliquity 23°. 28′. 7″,0, the right ascension is required.

With the given longitude the reduction is found	—2°. 26′. 19″,0
And its mutation - - -	12,7

Since therefore the given obliquity differs 8″ from 23°. 28′. 15″,0, say, as 60″ : is to 12″,7 : : so is 8″,0 : to a 4th number, 1″,7, which being substracted, leaves the true reduction—0ˢ. 2° 26.′17″,3

And therefore the right ascension required	1 .8 .58 .53 ,0
Or, - -	38 .58 .53 ,0

PROBLEM VIII.

The right ascension of the Sun or a point of the ecliptic, and the obliquity of the ecliptic being given, to find the corresponding longitude.

1. With the right ascension increased by three signs, find the proper reduction in the very same manner as in the preceding problem, for the given obliquity of the ecliptic, and from the same table.

2. Apply this according to its sign to the given right ascension, and the required longitude will be found.

EXAMPLE.

If the given obliquity be 23°. 28′. 7″,0, and the right ascension 38°. 58′. 53″,0, or 1ˢ. 8°. 58′. 53″,0, adding three signs to this we shall have 4ˢ. 8°. 58′. 53″,0, and therefore by the reduction + 2°. 26′. 19″,1, with the mutation 12″,9. Then say, as 60″ : is to 12″,9 : : so is the difference of the obliquities, 8″ : to a fourth number, 1″,7, which, substracted from + 2°. 26′. 19″,1, leaves the true reduction + 2°. 26′. 17″,4; hence the longitude required is 1ˢ. 11°. 25′. 10″,4.

PROBLEM IX.

The obliquity of the ecliptic, and the longitude of the Sun or a point of the ecliptic being given, to find the corresponding declination.

1. With the given longitude find the declination with its mutation or change.

2. Say, as 60″ : is to this mutation : : so is the difference between 23°. 28′. 15″,0, and the given obliquity : to a fourth number, which added to or substracted from the declination just found, according as the given obliquity is greater or less than 23°. 28′. 15″,0, will give the declination required; which will be north if marked in the table with the sign +, but south if distinguished with the sign —.

EXAMPLE.

EXAMPLE.

Let the logitude be 1ˢ. 11°. 25′. 10″,3, and the obliquity 23°. 28′. 7″,0, the declination is + 15°. 16′. 38″,0, and the mutation 37″,7. And as 60″ : is to 37″,7 : : so is 8″,0 to a fourth number, 5″,0; which, becauſe the given obliquity is leſs than 23°. 28′ 15″,0, muſt be ſubſtracted from 15°. 16′. 38″,0; Hence the true declination is 15°. 16′. 33″,0 +, or north.

PROBLEM X.

The obliquity of the ecliptic and declination of the Sun being given, to find his longitude.

1. Enter the table, with the given declination, and take out the mutation anſwering to it.

2. With this mutation and the difference of the obliquities find, as in the preceding problems, a fourth number, which ſubſtract from the given declination, if the given obliquity be greater than 23°. 28′. 15″,0, or add, if it be leſs; the reſult will be the declination, ſuch as it would be if the obliquity was 23°. 28′. 15″.

3. With this declination enter the ſame table again, and by making proportion find the longitude.

EXAMPLE.

On the firſt day of May 1756, the Sun's declination was obſerved 15°. 16′. 34″,2 north, and the obliquity of the ecliptic was 23°. 28′. 7″.0, the longitude of the Sun is required.

Since this declination has the mutation 37″,7 aſcribed to it in the table: ſay, as 60″ : is to 37″,7 : : ſo is 8″ : to a fourth number, 5″,0; therefore the declination would be + 15° 16′.39″,2, if the obliquity was as great as it is ſuppoſed in the table; wherefore from the ſame table the longitude of the Sun will be found either 1s. 11°. 25′. 11″,4 or 4s. 18°. 34′. 48″,6; but ſince in the month of May the Sun is in the aſcending ſigns, the firſt only in this caſe is the true one.

PROBLEM XI.

The obliquity of the ecliptic, and the longitude or right aſcenſion of any point of the ecliptic being given, to find the angle between the ecliptic and the parallel to the equator paſſing thro' that point.

1. If it be the longitude which is given, firſt find the right aſcenſion by problem VII.

2. With the right aſcenſion ſo found, or given, and increaſed by three ſigns, find the declination by problem IX. which, only with the change of its name, will repreſent the angle between the ecliptic and the parallel. And according as the ſign is + or —, the ecliptic will aſcend above, or deſcend below the parallel.

EXAMPLE.

Let the given right aſcenſion be 38°. 58′. 53″,0, which, increaſed by three ſigns, becomes 4ˢ. 8°. 58′. 53″,0. Hence by problem IX. for the obliquity 23°. 28′. 7″,0, there will be found 18°. 2′. 1″,4 +, wherefore ſo much the ecliptic is inclined to the parallel, and aſcends above it, or towards the north.

PROBLEM XII.

The Sun's diſtance from the zenith being given to find his parallax in a vertical circle.

This, which is alſo called the parallax in altitude, is eaſily found from its proper table, and is uſeful either for converting the obſerved diſtance from the zenith into the true, or the contrary. In the firſt caſe it is to be ſubſtracted from, and in the latter added to, the diſtance from the zenith. 2

USE *and* EXPLANATION *of the* TABLE *of* ASTRONOMICAL REFRACTIONS.

PROBLEM XIII.

The apparent diſtance of a celeſtial object from the zenith, and the temperature of the air ſhewn by the barometer and thermometer being given, to find the refraction.

IT is not the buſineſs of this place to treat largely of the nature of the aſtronomical refractions, or to explain the whole theory of them. But ſo much it ſeems proper to premiſe, that the refractions greatly depend on the viciſſitudes of the atmoſphere, and on its heat and elaſticity; and therefore it is neceſſary for obſervers, at the ſame time that they obſerve the altitude or zenith diſtance of a ſtar, to take notice alſo of the ſtate of the atmoſphere as ſhewn by the barometer and thermometer, and write it down in their journal. For ſince the modern practical aſtronomy is brought to this pitch, as to be almoſt wholly employed in ſearching out little niceties, and correcting ſmall errors, formerly overlooked, ſo neither is it proper to diſregard thoſe, which may affect obſervations from the variableneſs of the refractions. My table, which ſerves for computing the true refractions to any temperature of the air, in any part of the earth, requires the height of the barometer to be noted to twelfths of an inch or lines of the Paris foot, and the height of the thermometer according to Reaumur's ſcale: ſo that if the obſerver ſhould make uſe of a different meaſure, it muſt be firſt reduced to this before the refraction is computed†.

The firſt column of the table of refraction contains the refraction anſwering to every degree of zenith-diſtance, for that ſtate of the air, in which the height of the mercury in the barometer is 28 inch. 0 lin. and that of Reaumur's thermometer 10 degrees above the freezing point. The ſecond and third columns ſhew the variations of the refraction, the former for 10 lines of the barometer, and the latter for as many degrees of the thermometer; whence the proportional part is eaſily had for any other number of lines or degrees. Now the refraction is greater than the tabular one, and therefore the proportional part is to be added if the barometer is higher than 28 inches; the refraction is alſo greater if the thermometer is lower than 10+; but in the oppoſite caſes the refraction is leſs than the tabular one. But the uſe of the table will better appear by an example than by any further explanation.

EXAMPLE.

Let the obſerved zenith-diſtance be 70°. 20′. 5″, the height of the barometer being 27 inc. 5l. and that of the thermometer 4 degrees above the freezing point; the refraction is required.

By the table, the refraction anſwering to the zenith diſtance 70°. 20′. 5″ is - - -	2′. 39″,2
And the variation hereof, for 10 lines of the barometer	4, 8
For 10 degrees of the thermometer	7, 4

But as the given height of the barometer wants 7 lines of 28 inc. 0 l. ſay, as 10 l. is to 4″,8, ſo is 7l. to a fourth number, 3″,4; further, ſince four degrees of the thermometer differ 6 degrees from 10 degrees, ſay, as 10 is to 7″,4, ſo is 6 to a fourth number, 4″,4. Hence the true refraction will be 2′. 39″,2 — 3″,4, +4″,4, or 2′. 40″,2; the firſt correction being ſubſtracted on account of the given height of the barometer being leſs, and the ſecond correction additive, becauſe the thermometer was lower than the tabluar ones.

In

† A note is added, at the bottom of the table, ſhewing its relation to the Engliſh meaſure of length, and to the ſcale of Fahrenheit's thermometer.

In a note at the bottom of the table of astronomical refractions, we have referred that table to the height of the barometer expressed in English measure, and to the scale of Fahrenheit's thermometer, to the following effect: "This table also answers to the height of "the barometer 29,6 inches, English measure, and to 50° of Fahrenheit's thermometer; or to the height of the barometer 30 "English inches, and 55° of Fahrenheit's thermometer. And the "column of variation of refraction for 10 lines of the barometer, "Paris measure, answers to a difference of 9-10ths of an inch English measure, from the given height 29,6 or 30,00 inches; and "the column of variation of refraction of 10° of Reaumur's thermometer answers to a difference of 20° of Fahrenheit's thermometer from the given degree 50 or 55°." But the author, in the 1st scholium of this problem, having observed, that it is not safe to use proportional parts in zenith-distances exceeding 80 degrees, and having therefore delivered the algebraic formula of refraction upon which the table was constructed, directs the refraction to be thence deduced by direct calculation in that case; it may therefore be useful to reduce the formula to the English measure of length, and the scale of Fahrenheit's thermometer. Therefore,

Let the apparent zenith-distance be put $= \delta$

The height of the barometer expressed in English inches $= \beta$

And the height of Fahrenheit's thermometer $= \theta$.

And substituting the values of $b =, 9383\,\beta$, and $t = \frac{\theta - 32}{2\frac{1}{4}}$ in the formula, we shall have

$$\text{Refr.} = \frac{74'',408\beta \text{ sin. } \delta}{(1+0,002483\theta)^{\frac{3}{2}}}\left[\sqrt{\left(1+\frac{(17,143 \text{ cos. } \delta)^2}{1+0,002483\,\theta}\right)} - \frac{17,143 \text{ cos. } \delta}{(1+0,002483\theta)^{\frac{1}{2}}}\right]$$

$$= \frac{74'',408\beta \text{ sin. } \delta}{\left(1+\frac{\theta}{400}-\frac{\theta}{60000}\right)^{\frac{3}{2}}}\left[\sqrt{\left(1+\frac{(17,143. \text{ cos. } \delta)^2}{1+\frac{\theta}{400}-\frac{\theta}{60000}}\right)} - \frac{17,143 \text{ cos. } \delta}{\left(1+\frac{\theta}{400}-\frac{\theta}{60000}\right)^{\frac{1}{2}}}\right]$$

The computation may be very conveniently made from this formula (in a similar manner to what Mayer has shewn with respect to the other formula) as follows: find an angle ω whose tangent is

$$= \frac{\left(1+\frac{\theta}{400}-\frac{\theta}{60000}\right)^{\frac{1}{2}}}{17,143 \text{ cos. } \delta};\quad \text{and the refraction is} = \frac{74'',408\,\beta \text{ sin. } \delta \text{ tang. } \frac{1}{2}\,\omega}{\left(1+\frac{\theta}{400}-\frac{\theta}{60000}\right)^{\frac{3}{2}}}.$$

EXAMPLE.

On the 5th day of July 1756, the barometer standing at 29,485 English inches, and Fahrenheit's thermometer at 56 degrees, the zenith-distance of λ ♏ was observed at Gottingen 88°. 7'. 34″,0; the refraction is required.

$$\theta \text{ being} = 56, \left(1+\frac{\theta}{400}-\frac{\theta}{60000}\right)^{\frac{1}{2}} = (1+,14-,00093)^{\frac{1}{2}} = \sqrt{(1,13907)} \text{ and}$$

Log. $\sqrt{1,13907}$		= 0.02827
Compl. ar. log. 17,143		= 8.76592
Compl. ar. log. cos. δ		= 1.48546
Therefore tang. ω		= 10.27965
And hence ω		= 62°. 17'. 26″
and $\frac{1}{2}\,\omega$		= 31 . 8 . 43
Moreover log. tang. $\frac{1}{2}\,\omega$	9.78126	
log. 74″,408	1.87162	
log. β or log. 29,485	1.46960	
log. sin. δ	9.99977	
Compl. ar. log. $(1.13907)^{\frac{3}{2}}$	9.91519	
Whence log. refr.	= 3.03744	
And the refraction sought	= 1090″,0 or = 18'. 10″,0	

Ch. Mason's MAXIMA of EQUATIONS for Long. ☽.

Let ς = Sun's mean anomaly. p = Moon's mean anomaly. *p* = Moon's anomaly corrected. ω = Moon's mean distance from the Sun's true place. ω̃ = Moon's equated place from Sun's true place. δ = Moon's mean distance from the place of node corrected. ρ = Moon's equated distance corrected by the variation from the correct place of the node.

Annual Eq. ☽ M. An.	+ 21′. 41″,5 S. Arg. — 16″,3 S. twice Arg.	Arg. ⊙ Anom.
An. Eq. ☽ ☊	+ 9′. 11″,6 S. Arg. — 6″,7 S. twice Arg.	Arg. ⊙ Anom.
1. Eq. Long.	+ 11′. 8″,6 S. Arg. — 8″,9 S. twice Arg.	Arg. ⊙ Anom.
2. Eq. Long.	— 55″,9 S. 2ω+ς	Arg. 2 ☽ á ⊙ + ⊙ Anom.
3. Eq. Long.	— 1′. 15″,3 S. 2ω—ς	Arg. 2 ☽ á ⊙ — ⊙ Anom.
4. Eq. Long.	+ 57″,8 S. 2ω+ p	Arg. 2 ☽ á ⊙ + ☽ M. Anom.
5. Eq. Long.	— 80′. 28″,4 S. 2ω—p + 35″,1 S. 4ω—2p	Arg. 2 ☽ á ⊙ — ☽ M. Anom.
6. Eq. Long.	+ 2′. 3″,5 S. 2ω—p+ς	Arg. 2 ☽ á ⊙ — ☽ An. + ⊙ Anom.
7. Eq. Long.	+ 46″,5 S. 2ω—p—ς	Arg. 2 ☽ á ⊙ — ☽ An. — ⊙ An.
8. Eq. Long.	+ 42″, S. p—ς	Arg. ☽ M. An. — ⊙ M. Anom.
9. Eq. Long.	+ 22″,7 S. ω—p —57″,4 S. 2ω—2p	Arg. ☽ á ⊙ — ☽ M. Anom.
10. Eq. Long.	— 64″, S. 2δ—2ω	Arg. ⊙ — ☊ or Long. ⊙ — Long. ☊
11. Eq. Long.	— 17″, S. ω+ς	Arg. ☽ á ⊙ + ⊙ Anom.
12. Eq. Long.	— 3″,1 S. ω—ς	Arg. ☽ á ⊙ — ⊙ Anom.
13. Eq. Long.	— 3″,7 S. 2ω+2p	Arg. 2 ☽ á ⊙ + 2 ☽ M. Anom.
14. Eq. Long.	+ 12″,4 S. 4ω—p	Arg. 4 ☽ á ⊙ — ☽ Anom.
15. Eq. Long.	— 6″,3 S. 2δ—2p	Arg. 2 ☽ á ☊ — 2 ☽ Amom.
16. Eq. Long.	+ 8″,3 S. 2ω—2δ+p	Arg. 2 ☽ á ⊙ — 2 ☽ á ☊ + ☽ Anom.
17. Eq. Long.	— 5″,3 S. 2ω—2δ—p	Arg. 2 ☽ á ⊙ — 2 ☽ á ☊ — ☽ Anom.
18. Eq. Long.	+ 7″,7 S. δ	Arg. ☽ ☊
19. Eq. Long. or Eq. ☽'s Center	—6°. 18′. 14″,2 S. *p* + 12′. 56″,9 S. 2*p* — 36″,2 S. 3*p*	Arg. ☽ Anom. corrected by all the foregoing Eq. and the Ann. Eq. of ☽ Anom.
20. Eq. Variation ☽	— 1′. 56″,4 S. Arg. or S. ω̃ +35′. 41″,2×S. 2 Arg. or S. 2 ω̃ + 5″,2×S. 3 Arg. or S. 3 ω̃ + 8″,6×S. 4 Arg. or S. 4 ω̃	Arg. ☽ Long. corrected by all the preceding Equations — ⊙ Long.
21. Eq. gives ☽ place in her orbit	+ 1′. 24″,1 S. 2ρ—*p*	Arg. 2 ☽ á ☊ — ☽ Anom. correct.
22. Eq. Reduct. to the Ecliptic	— 6′. 47″,7 S. Arg. or S. 2ρ	Arg. ☽ correct. — ☊ correct.
23. Equinoxes	18″, S. δ	Arg. ☽ ☊

Ch. Mason's MAXIMA of EQUATIONS of ☽'s LATITUDE.

1 Eq Lat.	+ 5°. 8′. 44″,5 S. ρ — 4″,4 S. 3 ρ	Arg. ☽ in Orbit — ☊ correct.
2 Eq.	+ 8′. 48″,4 S. 2 ω̃ — δ	Arg. 2 ☽ in Orbit á ⊙ — Arg. 1.
3 Eq.	+ 3″,1 S. ρ — ς	Arg. Arg. 1 — ⊙ Anom.
4 Eq.	— 17″,6 S. ρ — p	Arg. Arg. 1 — ☽ Mean Anom.
5 Eq.	— 25″,1 S. ρ — 2 p	Arg. Arg. 4 — ☽ M. Anom.
6 Eq.	+ 1″,9 S. ρ — 3 p	Arg. Arg. 5 — ☽ M. Anom.
7 Eq.	— 9″, S. 2 ω̃ — ρ + ς	Arg. Arg. 2 + ⊙ Anom.
8 Eq.	— 3″,7 S. 2 ω̃ — ρ — ς	Arg. Arg. 2 — ⊙ Anom.
9 Eq.	— 2″,2 S. 2 ω̃ — ρ + p	Arg. Arg. 2 + ☽ M. Anom.
10 Eq.	+ 15″,9 S. 2 ω̃ — ρ — 2 p	Arg. Arg. 2 — ☽ M. Anom.
11 Eq.	— 5″,2 S. 2 ω̃ — ρ — 2 p	Arg. Arg. 10 — ☽ M. Anom.

PRECEPTS *for Calculating the* Moon's Place *by Mr Mason's* Lunar Tables.

Example.

Let it be required to find the ☽'s longitude and latitude, with her horary motion and parallax for the year 1791 N. S. on the 4th of Feb. at 0h. 5′. 3″ mean time at Greenwich.

Precepts.

1. Find the true longitude of the Sun, by the solar tables preceding, to the assigned time, reckoned from the mean equinox; by omitting the last of the four small equations or the equation of the equinoxes, together with his mean anomaly. By these tables you will find the true longitude of the Sun for the given instant to be
   10ˢ. 15°. 43′. 2″. = ⊙ long. and
   7 5 12 30 = ⊙ mean anomaly.

2. From the tables of the epochs, take out the mean motions of the moon's mean longitude, mean anomaly, and mean long. of her ascending node, for the year, month, day, hour, minute and second of the given time; placing each in their respective columns, and under the moon's mean-longitude, place her acceleration found in the table of Epochs.

Add up the the numbers in the columns of mean long. and mean anomaly, rejecting twelve signs whenever they occur and setting down the remainder, and you will have the mean longitude of the moon and her mean anomaly. But from the epoch of the node in the third column, substract the sum of all the numbers placed under it, which you have collected from the tables for months, days, hours, &c. and you will have the mean longitude of of the moon's ascending node. Thus you will have in the proposed example.

10ˢ. 26°. 8′. 12″,2 = m. Long. ☽
9 12 58 36 5 = m. Anom.
6 25 28 33 = ☽'s ☊.

3. Make two columns for receiving the positive and negative equations of the moon's longitude to be collected from the tables with their proper arguments placing each in their proper columns, according to the signs of the tables.

4. The argument of the first table for the ☽'s long. is the mean anomaly of the Sun, viz. in this example 7ˢ. 5°. 12′. 30″, with which you will find — 6′. 31″,9 to be placed in the column of negative equations.

5. If you substract the true longitude of the Sun, viz. 10ˢ. 15°. 43′. 2″. from the mean long. of the Moon, you will have the mean distance of the Moon from the Sun = 0ˢ. 10°. 25′. 10″.; to and from the double of which, viz. 0ˢ. 20°. 50′. 20″, add and substract the first argument, or ☉'s m. anom. = 7ˢ. 5°. 12′. 30″. and you will have the second and third arguments respectively; that is, for the second argument 7ˢ. 26°. 2′. 50″, by which you will find in the second table for the Moon's longitude the equation + 46″,4 to be placed in the column of positive equations in this example; and for the third argument you will have 5ˢ. 15°. 37′. 50″, with which, you will find in table the third = — 18″.7, for the column of negative equations.

6. To and from twice the Moon's mean distance from the Sun = 0ˢ. 20°. 50′. 20″, add and substract the mean anomaly of the Moon and you have the fourth and fifth argument; that is, for argument 4th in this case, 10ˢ. 3°. 49′. 65″, to which you will find — 48″. in the fourth table; and for the fifth argument you will have 3s. 7°. 51′. 3″,3, by which you will have — 3°. 19′. 52″,5 from table 5th, called the Evections.

7. To and from the fifth argument, viz. 3ˢ. 7°. 51′ 33″.5, add and substract the first argument, and you will have 10ˢ. 13°. 4′. 6″5 for the sixth argument, and 8ˢ. 2°. 39′. 3″,5, for the seventh argument by the first of which you will find — 1ˢ. 30″,2, and by the latter — 41″,3.

8. From the mean anomaly of the Moon substract the first argument or the Sun's mean anomaly, and you will have 2ˢ. 7°. 46′. 16″,5, for the eighth argument, with which, entering table 8th, you will find + 38″,9, for the equation.

9. From the mean distance of the Moon from the Sun, substract the moon's mean anomaly and you will have 2ˢ. 27°. 26′. 24″. for the ninth argument, with which in table 9th, you will have + 17″,6.

10. From the mean long. of the Moon's node substract the true long. of the Sun and you will have the tenth argument, viz. 8ˢ. 19°. 45′. 31″, with which you have in table 10th, + 39″2.

11. To the Moon's mean distance from the Sun add the Sun's anomaly, and you will have 7ˢ. 15°. 37′. 40″, for the eleventh argument, with which entering table 11th, you will find + 12″,1.

12. From the Moon's mean distance from the Sun substract the Sun's mean anomaly, and you will have 5ˢ. 5°. 12′ 40″, for the twelfth argument, with which you will find in table 12th, — 1″,3.

13. To twice the Moon's mean distance from the Sun add twice the Moon's mean anomaly, and you will have the thirteenth argument, viz. 7ˢ. 16°. 48′, with which you will find in table 13th, the equation + 2″,7.

14. From four times the Moon's mean distance from the Sun substract the Moon's mean anomaly, and you will have 3ˢ. 28°. 42′ for the fourteenth argument, with which you will find in table 14th, the equation, + 10″,9.

15. Substract the longitude of the Moon's node from the ☽'s mean longitude, and you will have her mean distance from her node, viz. 4ˢ. 0°. 39′. 39″, from the double of which, viz. 8ˢ. 10° 19′. 18″, substract the double of the Moon's mean anomaly, viz. 6ˢ. 25°. 57′. 33″, and you will have 1ˢ. 5°. 21′ 45″, for the fifteenth argument, with which you will find — 3″,6 for the equation in table 15th.

16. From the fourth argument, viz. 10ˢ. 3°. 49′. 7″, substract twice the Moon's mean distance from her node, and you will have 2ˢ. 2°. 29′ 49″, for the sixteenth argument, with which you will find + 7″,4, for the equation in table 16th.

17. From the fifth argument 3ˢ. 7°. 57′. 33″,5 substract twice the Moon's mean distance from her node, viz. 8ˢ. 1°. 19′. 18″, and you will have 7ˢ. 6°. 32′. 15″,5 for the seventeenth argument, with which you will find + 3″,2 for the equation in table 17th.

18. The mean longitude of the Moon's node is the eighteenth argument, viz. 6ˢ. 25°. 28′. 33″, with which take out the equation 3″,3 from table 18th.

19. Now add up the two columns of positive and negative equations separately and the difference of these sums with the sign of the greater is the sum of these eighteen equations of longitude. In the present case, the sum of the positive equations is + 2′. 58″,4, and the sum of the negative equations is — 1°. 29′. 52″,8, and their difference with the sign of the greater is — 1°. 26′. 54″,4 for the result of the whole eighteen preceding equations.

20. The next thing to be done is to corrct the ☽'s mean anomaly, for which purpose you have a table at the beginning of the lunar tables, (the argument being the Sun's mean anomaly), which is called *the Annual Equation* of the Moon's mean anomaly. Enter this table with its proper argument, the Sun's mean anomaly, viz. 7ˢ. 5°. 12′. 30″, and you will find — 12′. 46″, which added to — 1°. 26′. 54″,4, the sum of the eighteen preceding equations found before, will give — 1°. 39′: 40″,40 for the total correction, which applied according to its sign to the Moon's mean anomaly will give 9ˢ. 11°. 19′. 6″,1 the Moon's anomaly corrected, which is the argument of table 19th, entitled, the Equation of the Moon's center, where you will find the equation of the center = + 6°. 5′. 23″,0, which add to the result of the eighteeen equations, and you will have + 4°. 38′. 28″,4 for the result of the nineteen preceding equations.

21. Apply this amount of the nineteen equations, viz. 4s. 38′. 28″,4 to the mean dist. of the Moon from the Sun, viz. 0ˢ. 10°. 25′. 10″, and you will have the argument of table 20th, entitled the Variation, viz. 0ˢ. 15°. 3′. 38″,4; or, which is the same thing, apply this result of the nineteen equations to the Moon's mean longitude, and from the corrected longitude substract the Sun's true longitude, and you will have the same argument of table 20th, with which enter table 20th, and you will find + 17′. 35″,4, which apply to the aforesaid sum + 4°. 38′. 28″,4, and the sum will be 4°. 56′, 3″,8, which applied to the mean longitude of the Moon, viz. 10ˢ. 26°. 8′. 12″,2 according to its sign, will give 11ˢ. 1°. 4′. 16″, for the correct longitude of the Moon, in her orbit.

22. Now correct the longitude of the Moon's node, by entering the table for this purpose at the beginning of the lunar tables, entitled, the annual equation of the Moon's node, with it proper argument, viz. the Sun's mean anomaly, viz. 7ˢ. 5°. 12′. 30″, and you will have 5′. 24″,7, which applied to the mean longitude of the node 6ˢ. 25°. 28′. 33″,4, according to its sign will give 6ˢ. 25°. 23′. 8″,3 for the equated long. of the Moon's asc. node.

23. From the correct longitude of the Moon, viz. 11ˢ. 1°. 4. 16″, substract the equated longitude of the Moon's node, viz. 6ˢ. 25°. 23′. 8″.3, and the remainder, viz. 4ˢ. 5°. 41′. 7″,7, will be the equated distance of the Moon from her node; from the double of which, viz. 8ˢ. 11°. 22′. 15″,4 substract the Moon's corrected anomaly, viz. 9ˢ. 11°. 19′. 6″,1, there will remain 11ˢ. 0°. 3′. 9″,3 for the twenty-first argument, with which enter the

the 21ſt table, and you will find — 42″,0 for the equation, which apply to the correct longitude of the Moon, viz. 11ˢ. 1°. 4′. 16″, and you will have her longitude in her orbit farther corrected, viz. 11ˢ. 1°. 3′. 34″.

24. From her longitude in her orbit now found, 11ˢ. 1°. 3′. 34″, ſubſtract the equated or correct longitude of her aſcending node, found by the 22d precept, viz. 6ˢ. 25°. 23′. 8″,3, and you will have 4ˢ. 5°. 40′. 25″.7 for the argument of the 22d table, entitled Reduction, in which you will find the equation + 6′. 26″,3.

25. Laſtly, with the mean longitude of the Moon's node, not corrected, viz. 6ˢ. 25°. 28′. 33″ as the argument, enter the table entitled, the equation of the equinoctial points, and you will find + 7″,7, which together with the equation laſt found + 6′. 26″,3 being added to the Moon's laſt corrected longitude in her orbit, viz. 11ˢ. 1°. 3′. 34″, will give 11ˢ. 1°. 10′. 8″ for the true longitude of the Moon reduced to the ecliptic, and computed from the apparent equinox.

See the Arguments and Equations in the following Table for finding the Longitude of the Moon at the time propoſed.

						Equat. +	Equat. —
☉ Mean Anomaly	Arg. I.	7s,	5°,	12′,	30″,		— 0°, 6′, 31″,9
2 ☽ á ☉ + ☉ M. Anom.	Arg. II.	7	26	2	50	+ 00′ 46″,4	
2 ☽ á ☉ — ☉ M. Anom.	Arg. III.	5	15	37	50		— 18 7
2 ☽ á ☉ + ☽'s M. Anom.	Arg. IV.	10	3	49	6,5		— 48
2 ☽ á ☉ — ☽'s M. Anom.	Arg. V.	3	7	51	33,5		— 1 19 52 5
2 ☽ á ☉ — ☽'s M. Anom. + ☉ An.	Arg. VI.	10	13	4	6,5		— 1 30 2
2 ☽ á ☉ — ☽'s M. Anom. — ☉'s M. An.	Arg. VII.	8	2	39	3,5		— 41 3
☽ M. Anom. — ☉'s M. Anom.	Arg. VIII.	2	7	46	16,5	+ 38,9	
M. Diſt. ☽ á ☉ — ☽'s M. Anom.	Arg. IX.	2	27	26	24	+ 17,6	
Mean Long. ☊ — M. Long. ☉	Arg. X.	8	9	45	31	+ 39,2	
☽ á ☉ + ☉ Anom.	Arg. XI.	7	15	37	40	+ 12,1	
☽ á ☉ — ☉ Anom.	Arg. XII.	5	5	12	40		— 1 3
2 ☽ á ☉ + 2 ☽ M. Anom.	Arg. XIII.	7	16	48		+ 2,7	
4 ☽ á ☉ — ☽'s M. Anom.	Arg. XIV.	3	28	42		+ 10,9	
2 ☽ á ☊ — 2 ☽'s M. Anom.	Arg. XV.	1	5	21	45		— 3 6
2 ☽ á ☉ — 2 ☽ á ☊ + ☽'s M. Anom.	Arg. XVI.	2	2	29	49	+ 7,4	
2 ☽ á ☉ — 2 ☽ á ☊ — ☽'s M. Anom.	Arg. XVII.	7	6	32	15,5	+ 3,2	
Mean Longitude ☽'s ☊	Arg. XVIII.	6	25	28	33	′ ″	— 3 3
						+ 2 58,4	— 1 29 52 8
☽'s correct anomaly	Arg. XIX.	9	11	19	6,1	+ 6 5 23	′
☽'s equation long. — ☉ true longitude	Arg. XX.	0	15	3	38,4	+ 17 35,4	
Double Eq. Diſt. ☽ á ☊ — ☽'s cor. An.	Arg. XXI.	11	0	3	93		— 42
☽ Long. in orbit — correct longitude ☊	Arg. XXII.	4	5	40	25,7	+ 6 26,3	
Mean longitude ☊ ☉	Arg. XXIII.	6	25	28	33	+ 7,7	

Dif. =	—	1°,	26′,	54″6	
	+	6	5	23	
	+		17	35 4	
	+ 0	4	56	4	
	10	26	8	12,2	
☽ Long. in Orbit	11	1	4	16,2	
			—	42	
	11	1	3	34,2	
		+	6	26,3	
		+		7,7	
☽'s true Long. =	11	1	10	8,2	

PRECEPT for computing the MOON'S LATITUDE.

1. The 22d argument of longitude 4ˢ. 5°. 40′. 25″,7 found by precept 24th is the 1ſt argument of latitude, by which you have from the 1ſt table of latitude the equation + 4°. 10′. 46″,4.

2. To the 20th argument of longitude apply the ſum of the 20th and 21ſt equations of longitude, having regard to their ſigns, viz.+ 16′. 53″,4 and you have the true diſtance of the Moon in her orbit from the Sun, viz. 0s. 15°. 20′. 31″,8, from the double of which 1s. 0°. 41′. 3″,6, ſubſtract the 1ſt argument of latitude 4s. 5°. 40′. 27″,5, and you will have 8s. 25°. 0′. 37″,9 for the 2d argument of latitude, by which you get in table 2d — 8′. 46″,4 for the 2d equation of latitude.

3. From the 1ſt argument of latitude 4s. 5°. 40′. 25″,7, ſubſtract the mean anomaly of the Sun 7s. 5°. 12. 30″, and there will remain 9s. 0°. 27′. 55″,7 for the 3d argument which gives — 3″,1.

4. From 1ſt argument 4s. 5°. 40′. 25″,7, ſubſtract the mean anomaly of the Moon 9s. 12°. 58′. 46″,5, and there remains 6s. 22°. 41′. 39″,2 for the 4th argument, with which you get from table 4th + 6″,8.

5. From the 4th argument ſubſtract the Moon's mean anomaly, or from the firſt argument ſubſtract twice the Moon's mean anomaly, and you have 9s. 9°. 42′. 52″,7 for the fifth argument of latitude, with which you find in table 5th + 24″,7.

6. From the 5th argument ſubſtract the Moon's mean anomaly; or, from the firſt argument ſubſtract three times the Moon's mean anomaly, and there remains 11ˢ. 26°. 44′. 6″,2 for the 6th argument, with which you get — 0″,1 from table 6th.

7. To argument the 2d 8ˢ. 25°. 0′. 37″,9 of latitude, add the mean anomaly of the Sun 7ˢ. 5°. 12′. 30″ and their ſum 4ˢ. 0°. 13′. 7″,9 will be the 7th argument; with which you get — 7″,8.

8. From the 2d argument of latitude 8ˢ. 25°. 0′. 37″,9 ſubſtract the mean anomaly of the Sun, and the remainder 1ˢ. 19°. 48′. 7″,9 will be the 8th argument, with which you get — 2″,8.

9. To the 2d argument of latitude 8ˢ. 25°. 0′. 37″,9, add the Moon's mean anomaly, 9s, 12°. 58′. 46″,5, and the Sum 6s. 7°. 59′. 24″,4 is the 9th argument, with which you have + 0″,3.

10. From the ſecond argument ſubſtract the Moon's mean anomaly, and the remainder 11s. 12°. 1′. 51″.4 is the 10th argument, with which you get — 4″,9.

11. From the 10th argument ſubſtract the mean anomaly of the Moon, and the remainder 1s. 29°. 3′. 4″,9 is the 11th argument, with which you find — 4″,5.

The ſum of the additive equations is 4°. 11′. 18″,2, and the ſum

sum of the substractive equations is 9′. 9″,6 and their amount or difference + 4°. 2′. 8″,6 is the true latitude of the Moon; and it is north latitude, because the sum of the positive equations exceeds the sum of the substractive or negative equations. Had the negative equations exceeded the positive the latitude would have been south.

PROBLEM.

To find the EQUATORIAL PARALLAX *of the* MOON.
Precepts for finding the horizontal Parallax of the Mooon at the Equator.

With the first ten arguments for the Moon's longitude take out so many equations from the first ten tables of parallax, and the three other equations from the remaining three tables, with the 19th, 20th, and 21st arguments of longitude, with their proper signs. From the sum of the affirmative numbers substract the sum of the negative numbers, and the remainder is the moon's equatorial parallax, or her horizontal parallax for a place under the equator. In our example you will find the sum of the positive numbers + 56′. 54″,3, and of the negative numbers — 2″,5, and their difference is 56′. 51″,8 for the equat. parallax.

To find the horizontal parallax for any latitude, and to reduce that latitude to the center of the earth, when the equat. parallax is given.

PRECEPT.

Enter the table entitled, *for finding the horizontal parallax from the equatorial parallax, and for reducing the latitude to the earth's center*, with its argument, viz. the latitude on the side, and the equatorial parallax on the top, and find the reduction of parallax, which substracted from the equatorial parallax leaves the horizontal parallax required. Take also the reduction of the latitude from the same table, which substracted from the given latitude, gives the latitude reduced to the earth's center.

N. B. The parallax and reduced latitude should be used in computing the moon's parallaxes in longitude, latitude, right ascension, and declination. For hereby they may be computed by the common rules upon the supposition of the earth's being a perfect sphere, as both are hereby referred to the center of the earth.

In our example you will find for the latitude 42°. and the equatorial parallax found above 6″,7 of a reduction to be substracted from it, to give the horizontal parallax in that latitude; and for the reduction of the latitude to the center of the earth — 14′ 51″.

The next table for finding the Moon's diameter from her equatorial parallax needs no explication, as you have her diameter answering to any parallax given. Or it may be found for any latitude from the horizontal parallax, by this proportion: as 54′ 56″. : 30′. 0″. : : the horizontal parallax for any latitude : to the moon's horizontal diameter required.

To find the horary motion of the Moon in longitude.

The first ten equations are taken from the tables of horary motion in longitude by the first ten arguments of longitude, and the other four with the arguments 19, 20, 21, 22. Find the sum of the first thirteen of these equations by substracting the sum of the negative from the sum of the positive, and the moon's horary motion in her orbit will be obtained. Then say, as 32′. 56″, is to the Moon's horary motion in her orbit just found, so is the number taken out of the last table, to a fourth, which will be the same equation corrected, to be applied according to its sign in the last table to the Moon's hourly motion in her orbit, to have her horary motion with respect to the ecliptic. In our example, you will find 32′. 40″,3 for the sum of the thirteen equations, and in the 14th table + 2″,5, the reduction of which by the above proportion will be insensible, and therefore, the horary motion with respect to the ecliptic will be 32′. 42,″8.

To find the Moon's horary motion in latitude.

With argument I. and II. of latitude, take out the two equations from the two tables of the Moon's horary motion in latitude, and the sum, if they have the same sign, or their difference, if they have contrary signs, with the sign of the greater will be the Moon's mean hourly motion in latitude. Then say, as 32′, 56″, is to the Moon's horary motion in her orbit, found by the last problem, so is the mean horary motion in latitude to her true hourly motion in latitude, which will be north, if marked with the sign +, but south if marked with the sign —.

EQUATION of TIME.

Sun's apogee in 8°. Cancer, agreeing with the year A. C. 1716.

Argu. Sun's true Longitude.

S.	0	1	2	3	4	5	6	7	8	9	10	11	S.
	±	−	∓	+	+	±	−	−	−	∓	+	+	
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	°
0	7 37	1 13	3 58	1 5	5 51	2 17	7 38	15 30	13 27	1 4	11 37	14 25	0
1	7 18	1 26	3 54	1 19	5 53	2 1	7 59	15 37	13 10	0 35	11 54	14 19	1
2	6 59	1 39	3 50	1 32	5 54	1 45	8 20	15 44	12 53	0 5	12 10	14 12	2
										+			
3	6 41	1 52	3 45	1 46	5 55	1 28	8 40	15 50	12 35	0 25	12 25	14 5	3
4	6 22	2 4	3 40	1 59	5 55	1 11	9 0	15 55	12 16	0 54	12 39	13 57	4
5	6 2	2 16	3 34	2 12	5 54	0 53	9 20	15 59	11 57	1 24	12 53	13 48	5
6	5 43	2 27	3 27	2 25	5 53	0 35	9 40	16 3	11 37	1 53	13 6	13 39	6
7	5 24	2 38	3 20	2 38	5 51	0 17	10 0	16 6	11 16	2 22	13 19	13 29	7
						−							
8	5 5	2 48	3 12	2 51	5 49	0 2	10 19	16 8	10 55	2 51	13 31	13 18	8
9	4 46	2 58	3 4	3 3	5 46	0 21	10 38	16 9	10 33	3 20	13 42	13 7	9
10	4 27	3 7	2 55	3 15	5 42	0 40	10 57	16 10	10 10	3 48	13 52	12 55	10
11	4 8	3 15	2 46	3 27	5 37	1 0	11 15	16 10	9 47	4 16	14 1	12 43	11
12	3 49	3 23	2 37	3 38	5 32	1 20	11 33	16 9	9 23	4 44	14 9	12 31	12
13	3 30	3 30	2 27	3 50	5 26	1 40	11 50	16 7	8 59	5 11	14 17	12 18	13
14	3 12	3 37	2 17	4 1	5 20	2 0	12 7	16 4	8 34	5 38	14 24	12 4	14
15	2 53	3 43	2 6	4 11	5 13	2 21	12 24	16 0	8 8	6 4	14 30	11 50	15
16	2 35	3 48	1 55	4 21	5 5	2 42	12 40	15 56	7 42	6 30	14 35	11 35	16
17	2 17	3 53	1 44	4 31	4 57	3 2	12 56	15 51	7 15	6 56	14 39	11 20	17
18	1 59	3 57	1 32	4 40	4 48	3 23	13 11	15 45	6 48	7 21	14 42	11 5	18
19	1 42	4 0	1 20	4 49	4 39	3 44	13 26	15 38	6 21	7 46	14 44	10 49	19
20	1 24	4 3	1 8	4 57	4 29	4 5	13 40	15 30	5 53	8 10	14 46	10 33	20
21	1 7	4 5	0 55	5 5	4 18	4 27	13 54	15 21	5 25	8 34	14 47	10 17	21
22	0 50	4 7	0 42	5 12	4 7	4 48	14 7	15 12	4 57	8 57	14 48	10 0	22
23	0 33	4 8	0 29	5 19	3 55	5 10	14 20	15 2	4 28	9 19	14 48	9 43	23
24	0 17	4 8	0 16	5 25	3 43	5 31	14 32	14 51	3 59	9 41	14 47	9 26	24
25	0 1	4 8	0 3	5 31	3 30	5 53	14 43	14 39	3 30	10 2	14 45	9 8	25
	−		+										
26	0 15	4 7	0 11	5 36	3 16	6 14	14 54	14 26	3 1	10 22	14 42	8 50	26
27	0 30	4 6	0 24	5 41	3 2	6 35	15 4	14 12	2 32	10 42	14 39	8 32	27
28	0 45	4 4	0 38	5 45	2 47	6 56	15 13	13 58	2 3	11 1	14 35	8 14	28
29	0 59	4 1	0 52	5 48	2 32	7 17	15 22	13 43	1 34	11 19	14 30	7 56	29
30	1 13	3 58	1 5	5 51	2 17	7 38	15 30	13 27	1 4	11 37	14 25	7 37	30

☞ + Added to the apparent time } to have the mean time.
— Subtracted

EQUATION of TIME.

Sun's apogee in 9°. Cancer, agreeing with the year A. C. 1771.

Argu. Sun's true Longitude.

S.	0	1	2	3	4	5	6	7	8	9	10	11	S.
	±	−	∓	+	+	±	−	−	−	∓	+	+	
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	°
0	7 36	1 10	3 52	1 13	5 58	2 21	7 37	15 33	13 33	1 12	11 29	14 20	0
1	7 17	1 23	3 48	1 27	6 0	2 5	7 58	15 41	13 17	0 42	11 46	14 14	1
2	6 58	1 36	3 44	1 40	6 1	1 49	8 19	15 48	13 0	0 13	12 2	14 7	2
										+			
3	6 40	1 49	3 39	1 54	6 2	1 32	8 39	15 53	12 42	0 17	12 18	14 0	3
4	6 21	2 1	3 33	2 7	6 2	1 15	8 59	15 58	12 23	0 46	12 33	13 52	4
5	6 2	2 13	3 27	2 20	6 2	0 57	9 19	16 3	12 3	1 16	12 47	13 43	5
6	5 43	2 24	3 20	2 33	6 1	0 39	9 39	16 7	11 43	1 45	13 0	13 34	6
7	5 24	2 34	3 13	2 46	5 59	0 21	9 59	16 10	11 22	2 14	13 12	13 24	7
8	5 5	2 43	3 5	2 59	5 56	0 2	10 19	16 12	11 1	2 43	13 24	13 14	8
						−							
9	4 46	2 52	2 57	3 11	5 53	0 17	10 38	16 13	10 39	3 11	13 35	13 3	9
10	4 27	3 1	2 48	3 23	5 49	0 36	10 57	16 14	10 16	3 40	13 45	12 52	10
11	4 8	3 9	2 39	3 35	5 44	0 56	11 15	16 14	9 53	4 8	13 54	12 40	11
12	3 50	3 17	2 30	3 47	5 39	1 16	11 33	16 13	9 29	4 36	14 2	12 27	12
13	3 31	3 25	2 20	3 58	5 33	1 37	11 51	16 11	9 5	5 3	14 10	12 14	13
14	3 13	3 32	2 10	4 9	5 26	1 57	12 8	16 8	8 40	5 30	14 17	12 0	14
15	2 54	3 38	1 59	4 19	5 19	2 18	12 25	16 5	8 15	5 56	14 23	11 46	15
16	2 36	3 43	1 48	4 29	5 11	2 39	12 41	16 1	7 49	6 22	14 28	11 32	16
17	2 18	3 47	1 36	4 39	5 3	3 0	12 57	15 56	7 22	6 48	14 32	11 17	17
18	2 0	3 51	1 24	4 48	4 54	3 21	13 13	15 50	6 55	7 13	14 36	11 2	18
19	1 42	3 54	1 12	4 57	4 44	3 42	13 28	15 43	6 28	7 38	14 39	10 47	19
20	1 25	3 57	1 0	5 5	4 34	4 3	13 43	15 35	6 0	8 2	14 41	10 31	20

EQUATION of TIME.

Sun's apogee in 9° Cancer, agreeing with the year A. C. 1771.

Argu. Sun's true Longitude.

S.	0	1	2	3	4	5	6	7	8	9	10	11	S.
	±	−	∓	+	+	±	−	−	−	∓	+	+	
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	°
21	1 8	3 59	0 47	5 13	4 23	4 25	13 57	15 26	5 32	8 26	14 42	10 15	21
22	0 51	4 1	0 34	5 20	4 12	4 46	14 10	15 17	5 4	8 49	14 42	9 58	22
23	0 35	4 2	0 21	5 27	4 0	5 8	14 22	15 7	4 36	9 11	14 42	9 41	23
24	0 19	4 2	0 8	5 33	3 48	5 29	14 34	14 56	4 7	9 33	14 41	9 24	24
			+										
25	0 3	4 2	0 5	5 39	3 35	5 51	14 45	14 44	3 38	9 54	14 39	9 7	25
	−												
26	0 12	4 1	0 19	5 44	3 21	6 12	14 56	14 31	3 9	10 14	14 37	8 49	26
27	0 27	4 0	0 32	5 48	3 7	6 34	15 6	14 18	2 40	10 34	14 34	8 31	27
28	0 42	3 58	0 46	5 52	2 52	6 55	15 16	14 4	2 11	10 53	14 30	8 13	28
29	0 56	3 55	0 59	5 55	2 37	7 16	15 25	13 49	1 41	11 11	14 25	7 55	29
30	1 10	3 52	1 13	5 58	2 21	7 37	15 33	13 33	1 12	11 29	14 20	7 36	30

☞ + Added to the apparent time } to have the mean time.
— Subtracted

Difference of Time from the Meridian of Greenwich of the following Places, with the Elevation of the Pole.

Names of Places.		Difference of Meridians h ′ ″		Latitude. ° ′ ″
Abo,	*Finland*	1 28 50	—	60 27 10
Aix,	*France*	0 21 39	—	43 31 35
Alexandria,	*Egypt*	2 1 2	—	31 11 20
Amſterdam,	*Holland*	0 19 2	—	52 22 45
Antwerp,	*Flanders*	0 17 31	—	51 13 15
Avignon	*France*	0 19 8	—	43 57 25
Baſil,	*Switzerland*	0 29 58	—	47 35 0
Bayonne,	*France*	0 6 1	+	43 29 21
Berlin	*Germany*	0 53 44	—	52 32 30
Bologna,	*Italy*	0 45 21	—	44 29 36
Bourdeaux,	*France*	0 2 20	+	44 50 18
Breſt,	*France*	0 18 0	+	48 23 0
Bruſſels,	*Germany*	0 17 21	—	50 51 0
Cadiz,	*Spain*	0 24 9	+	26 31 7
Cairo,	*Egypt*	2 5 41	—	30 2 20
Calais,	*France*	0 7 29	—	50 57 31
Cape of Good Hope,	*Africa*	1 13 56	—	33 55 15A.
Canton,	*China*	7 32 6	—	23 8 0
Carthagena,	*America*	5 1 49	+	10 26 35
Caſſel,	*Germany*	0 37 52	—	51 19 4
Cayenne,	*America*	3 29 4	+	4 56 10
Conception,	*America*	4 52 54	+	36 42 53A.
Conſtantinople,	*Turkey*	1 55 30	—	41 0 0
Copenhagen,	*Denmark*	0 50 57	—	55 40 45
Dantzick,	*Poland*	1 14 26	—	54 22 0
Edinburgh,	*Scotland*	0 12 25	+	55 58 0
Florence,	*Italy*	0 44 4	—	43 46 30
Genoa,	*Italy*	0 34 19	—	44 25 0
Gottenburgh,	*Sweden*	0 45 31	—	57 42 0
Gottingen,	*Germany*	0 39 32	—	51 31 54
Greenwich,	*England*	0 0 0		51 28 39
Gripſwald,	*Germany*	0 54 30	—	54 4 25
Ingoldſtadt,	*Germany*	1 45 26	—	59 21 40
Leipſic,	*Germany*	0 49 16	—	48 45 45
Lima,	*America*	5 7 22	+	12 1 15A.
Liſbon,	*Portugal*	0 36 34	+	38 42 20
London,	*England*	0 0 26	+	51 31 0
Louiſburg,	*America*	3 59 44	+	45 53 45
Lyons,	*France*	0 19 12	—	45 45 51
Macao,	*China*	7 35 1	—	22 12 44

Difference of Time from the Meridian of Greenwich of the following Places with the Elevation of the Pole.

Names of Places.		Difference of Meridian. h	′	″		Latitude. °	′	″
Madrid,	*Spain*	0	15	2	+	40	25	0
Malta,	*Africa*	0	57	50	—	35	54	0
Marſeilles,	*France*	0	21	21	—	43	17	45
Milan,	*Italy*	0	37	2	—	45	25	0
Mons,	*Germany*	0	45	56	—	48	9	55
Montpelier,	*France*	0	15	25	—	43	36	33
Moſcow,	*Ruſſia*	2	31	1	—	55	45	20
Nantes,	*France*	0	6	15	+	47	13	17
Naples,	*Italy*	0	56	51	—	40	50	45
Narbonne,	*France*	0	11	56	—	43	11	13
Nuremberg,	*Germany*	0	44	28	—	49	27	10
Orleans,	*France*	0	7	34	—	47	54	4
Paris,	*France*	0	9	16	—	48	50	14
Pekin,	*China*	7	45	26	—	39	55	16
Peterſburgh,	*Ruſſia*	2		13	—	59	56	0
Philadelphia,	*America*	5	0	35	+	39	56	54
Quebec,	*America*	4	39	36	+	46	55	0
Quito,	*America*	5	11	44	+	0	13	17 A.
Rimini,	*Italy*	0	50	13	—	44	3	43
Rome,	*Italy*	0	49	49	—	41	53	54
Siam,	*India*	6	43	16	—	14	18	0
Smyrna,	*Aſia*	1	49	15	—	38	28	7
Straſburg,	*Germany*	0	30	56	—	48	34	35
Stockholm,	*Sweden*	1	12	26	—	59	21	40
Toulon,	*France*	0	23	39	—	43	7	24
Turin,	*Italy*	0	30	36	—	45	5	20
Venice,	*Italy*	0	49	16	—	45	27	0
Vienna,	*Germany*	1	5	32	—	48	11	20
Upſal,	*Sweden*	1	10	53	—	59	51	50
Uraniburg,	*Sweden*	0	51	26	—	55	54	15
Wittenberg,	*Germany*	0	50	46	—	51	49	0

+ Add } the given time of thoſe places } to have the time at Greenwich.
— Subtract

TABLE of the Sun's mean motion, preceſſion of the Equinoxes, and decreaſe of the obliquity of the Ecliptic, in Julian years.

Julian Years.	Mean Long. ☉ s	°	′	″	Mean Apo. s	°	′	″	I. ☽ N.	II. ♃ N.	III. ♀ N.	IV. ☊ N.	Prec. Equi. s	°	′	″	Decre. ob. Ec. ′	″
1	11	29	45	40,7	0	0	1	6	360	915	625	54	0	0	0	50,3	0	0,5
2	11	29	31	21,5	0	0	2	12	720	830	250	107	0	0	1	40,6	0	0,9
3	11	29	17	2,2	0	0	3	18	80	745	875	161	0	0	2	30,9	0	1,4
B. 4	0	0	1	51,3	0	0	4	24	474	663	502	215	0	0	3	21,2	0	1,8
5	11	29	47	32,1	0	0	5	30	834	578	127	268	0	0	4	11,5	0	2,3
6	11	29	33	12,8	0	0	6	36	194	493	752	322	0	0	5	1,8	0	2,8
7	11	29	18	53,6	0	0	7	42	554	408	377	376	0	0	5	52,1	0	3,2
B. 8	0	0	3	42,6	0	0	8	48	948	325	4	430	0	0	6	42,4	0	3,7
9	11	29	49	23,4	0	0	9	54	308	240	629	483	0	0	7	32,7	0	4,1
10	11	29	35	4,1	0	0	11	0	668	155	254	537	0	0	8	23,0	0	4,6
11	11	29	20	44,9	0	0	12	6	28	70	879	591	0	0	9	13,3	0	5,1
B. 12	0	0	5	34,0	0	0	13	12	422	988	506	645	0	0	10	3,6	0	5,5
13	11	29	51	14,7	0	0	14	18	782	903	131	698	0	0	10	53,9	0	6,0
14	11	29	36	55,5	0	0	15	24	142	818	756	752	0	0	11	44,2	0	6,4
15	11	29	22	36,2	0	0	16	30	502	733	381	806	0	0	12	34,5	0	6,9
B. 16	0	0	7	25,3	0	0	17	36	896	651	8	860	0	0	13	24,8	0	7,4
17	11	29	53	6,0	0	0	18	42	257	566	633	913	0	0	14	15,1	0	7,8
18	11	29	38	46,8	0	0	19	48	617	481	258	967	0	0	15	5,4	0	8,3
19	11	29	24	27,5	0	0	20	54	977	396	883	21	0	0	15	55,7	0	8,7
B. 20	0	0	9	16,6	0	0	22	0	371	314	510	75	0	0	16	46,0	0	9,2
B. 40	0	0	18	33,2	0	0	44	0	741	627	21	149	0	0	33	32,0	0	18,4
B. 60	0	0	27	49,8	0	1	6	0	112	941	531	224	0	0	50	18,0	0	27,6

TABLE of the Sun's mean motion, preceſſion of the Equinoxes, and decreaſe of the obliquity of the Ecliptic in Julian years.

Julian Years.	Mean Lon. ☉ s	°	′	″	Mean Apo. s	°	′	″	I. ☽ N.	II. ♃ N.	III. ♀ N.	IV. ☊ N.	Preceſ. Equi. s	°	′	″	Decre. ob. Ec.	″
B. 80	0	0	37	6,4	0	1	28	0	482	254	41	298	0	1	7	4,0	0	36,8
B. 100	0	0	46	23,0	0	1	50	0	853	568	551	373	0	1	23	50,0	0	46,0
B. 200	0	1	32	46,0	0	3	40	0	706	136	102	746	0	2	47	40,0	1	32,0
B. 300	0	2	19	9,0	0	5	30	0	559	704	654	118	0	4	11	30,0	2	18,0
B. 400	0	3	5	32,0	0	7	20	0	412	272	205	491	0	5	35	20,0	3	4,0
B. 500	0	3	51	55,0	0	9	10	0	265	840	756	864	0	6	59	10,0	3	50,0
B. 600	0	4	38	18,0	0	11	0	0	119	408	307	237	0	8	23	0,0	4	36,0
B. 700	0	5	24	41,0	0	12	50	0	972	976	858	609	0	9	46	50,0	5	22,0
B. 800	0	6	11	4,0	0	14	40	0	825	544	410	982	0	11	10	40,0	6	8,0
B. 900	0	6	57	27,0	0	16	30	0	678	112	961	355	0	12	34	30,0	6	54,0
B. 1000	0	7	43	50,0	0	18	20	0	531	680	512	27	0	13	58	20,0	7	40,0
B. 2000	0	15	27	40,0	1	6	40	0	62	359	24	455	0	27	56	40,0	15	20,0
B. 3000	0	23	11	30,0	1	25	0	0	593	39	536	182	1	11	55	0,0	23	0,0
B. 4000	1	0	55	20,0	2	13	20	0	124	718	48	910	1	25	53	20,0	30	40,0
B. 5000	1	8	39	10,0	3	1	40	0	655	398	560	637	2	9	51	40,0	38	20,0
B. 6000	1	16	23	0,0	3	20	0	0	186	78	72	365	2	23	50	0,0	46	0,0

Epochs of the Sun's mean motion.
Mean time under the meridian of Greenwich Obſervatory.

Julian Style.		Mean Long. ☉ s	°	′	″	Long. Apogee. s	°	′	″	I. ☽ N.	II. ♃ N.	III. ♀ N.	IV. ☊ N.
Years before Chriſt.	600	9	3	11	2,9	1	25	32	36	87	951	918	964
	500	9	3	57	25,9	1	27	22	36	940	519	469	387
	400	9	4	43	48,9	1	29	12	36	793	87	20	709
	300	9	5	30	11,9	2	1	2	36	646	655	571	82
	200	9	6	16	34,9	2	2	52	36	499	223	122	454
	100	9	7	2	57,9	2	4	42	36	352	791	674	827
	0	9	7	49	20,9	2	6	32	36	206	359	225	200
Years after Chriſt.	100	9	8	35	43,9	2	8	22	36	59	927	776	573
	200	9	9	22	6,9	2	10	12	36	912	495	327	946
	300	9	10	8	29,9	2	12	2	36	765	63	878	318
	400	9	10	54	52,9	2	13	52	36	618	631	430	691
	500	9	11	41	15,9	2	15	42	36	471	199	981	64
	600	9	12	27	38,9	2	17	32	36	325	767	532	437
	700	9	13	14	1,9	2	19	22	36	178	335	83	809
	800	9	14	0	24,9	2	21	12	36	31	903	635	182
	900	9	14	46	47 9	2	23	2	36	884	471	186	555
	1000	9	15	33	10,9	2	24	52	36	737	39	737	927
	1100	9	16	19	33,9	2	26	42	36	590	607	288	300
	1200	9	17	5	56,9	2	28	32	36	443	175	839	673
	1300	9	17	52	19,9	3	0	22	36	296	743	381	46
	1400	9	18	38	42,9	3	2	12	36	150	311	942	418
	1460	9	19	6	32,7	3	3	18	36	262	252	473	642
	1480	9	19	15	49,3	3	3	40	36	632	565	983	716
	1500	9	19	25	5,9	3	4	2	36	3	879	493	791
	1520	9	19	34	22,5	3	4	24	36	374	193	3	866
	1540	9	19	43	39,1	3	4	46	36	744	506	514	940
	1560	9	19	52	55,7	3	5	8	36	115	820	24	15
	1580	9	20	2	12,3	3	5	30	36	485	133	534	89
	1600	9	20	11	28,9	3	5	32	36	856	444	44	163
	1620	9	20	20	45,5	3	6	14	36	227	758	554	238
	1640	9	20	30	2,1	3	6	36	36	597	71	64	313
	1660	9	20	39	18,7	3	6	58	36	968	385	574	387
	1680	9	20	48	35,3	3	7	20	36	338	698	85	462
	1700	9	20	57	51,9	3	7	42	36	708	12	595	537
	1701	9	20	43	32,6	3	7	43	42	68	927	220	591
	1702	9	20	29	13,4	3	7	44	48	428	842	845	644
	1703	9	20	14	54,1	3	7	45	54	788	757	470	698
	1704	9	20	59	43,2	3	7	47	0	182	675	97	752
	1705	9	20	45	24,0	3	7	48	6	542	590	722	806
	1706	9	20	31	4,7	3	7	49	12	902	505	347	859
	1707	9	20	16	45,5	3	7	50	18	262	420	972	913
	1708	9	21	1	34,5	3	7	51	24	656	337	599	967
	1709	9	20	47	15,3	3	7	52	30	16	252	224	20
	1710	9	20	32	56,0	3	7	53	36	376	167	849	74
	1711	9	20	18	36,8	3	7	54	42	736	82	474	128

Epochs of the Sun's mean motion.
Mean time under the Meridian of Greenwich Obfervatory.

Julian Style.		MeanLong. ☉				Long. Apo.				I. ☽	II. ♃	III. ♀	IV. ☊
		s	°	′	″	s	°	′	″	N.	N.	N.	N.
Years after Chrift.	1712	9	21	3	25,9	3	7	55	48	130	0	101	182
	1713	9	20	49	6,6	3	7	56	54	490	915	726	235
	1714	9	20	34	47,4	3	7	58	0	850	830	351	289
	1715	9	20	20	28,1	3	7	59	6	210	745	976	343
	1716	9	21	5	17,2	3	8	0	12	604	663	603	397
	1717	9	20	50	57,9	3	8	1	18	965	578	228	450
	1718	9	20	36	38,7	3	8	2	24	325	493	853	504
	1719	9	20	22	19,4	3	8	3	30	685	408	478	558
	1720	9	21	7	8,5	3	8	4	36	79	326	105	612
	1721	9	20	52	49,2	3	8	5	42	439	241	730	665
	1722	9	20	38	30,0	3	8	6	48	799	156	355	719
	1723	9	20	24	10,7	3	8	7	54	159	71	980	773
	1724	9	21	8	59,8	3	8	9	0	553	989	607	827
	1725	9	20	54	40,6	3	8	10	6	913	904	232	880
	1726	9	20	40	21,3	3	8	11	12	273	819	857	934
	1727	9	20	26	2,1	3	8	12	18	633	734	482	988
	1728	9	21	10	51,1	3	8	13	24	27	651	109	41
	1729	9	20	56	31,9	3	8	14	30	387	566	734	95
	1730	9	20	42	12,6	3	8	15	36	747	481	359	149
	1731	9	20	27	53,4	3	8	16	42	107	396	984	203
	1732	9	21	12	42,5	3	8	17	48	501	314	611	256
	1733	9	20	58	23,2	3	8	18	54	861	229	236	310
	1734	9	20	44	4,0	3	8	20	0	221	144	861	364
	1735	9	20	29	44,7	3	8	21	6	581	59	487	418
	1736	9	21	14	33,8	3	8	22	12	975	977	114	471
	1737	9	21	0	14,5	3	8	23	18	335	892	739	525
	1738	9	20	45	55,3	3	8	24	24	695	807	364	579
	1739	9	20	31	36,0	3	8	25	30	55	722	989	633
	1740	9	21	16	25,1	3	8	26	36	449	639	616	686
	1741	9	21	2	5,8	3	8	27	42	809	554	241	740
	1742	9	20	47	46,6	3	8	28	48	169	469	866	794
	1743	9	20	33	27,3	3	8	29	54	529	384	491	848
	1744	9	21	18	16,4	3	8	31	0	923	302	118	901
	1745	9	21	3	57,2	3	8	32	6	283	217	743	955
	1746	9	20	49	37,9	3	8	33	12	643	132	368	9
	1747	9	20	35	18,7	3	8	34	18	3	47	993	62
	1748	9	21	20	7,7	3	8	35	24	397	964	620	116
	1749	9	21	5	48,5	3	8	36	30	757	879	245	170
	1750	9	20	51	29,2	3	8	37	36	117	794	870	224
	1751	9	20	37	10,0	3	8	38	42	477	709	495	277
	1752	9	21	21	59,1	3	8	39	48	871	627	122	331

Gregorian Style.		MeanLong. ☉				Long. Apo.				I. ☽	II. ♃	III. ♀	IV. ☊
		s	°	′	″	s	°	′	″	N.	N.	N.	N.
Years after Chrift.	1600	9	10	20	5,6	3	5	52	34	517	419	27	162
	1620	9	10	29	22,2	3	6	14	34	888	733	537	237
	1640	9	10	38	38,8	3	6	36	34	258	46	47	312
	1660	9	10	47	55,4	3	6	58	34	629	360	557	386
	1680	9	10	57	12,0	3	7	20	34	999	673	68	461
	1700	9	10	7	20,3	3	7	42	34	336	984	576	535
	1701	9	9	53	1,0	3	7	43	40	596	899	201	589
	1702	9	9	38	41,8	3	7	44	46	56	814	826	642
	1703	9	9	24	22,5	3	7	45	52	416	729	451	696
	1704	9	10	9	11,6	3	7	46	58	310	647	78	750
	1705	9	9	54	52,4	3	7	48	4	170	562	703	804
	1706	9	9	40	33,1	3	7	49	10	530	477	328	857
	1707	9	9	26	13,9	3	7	50	16	890	392	953	911
	1708	9	10	11	2,9	3	7	51	22	284	309	580	965
	1709	9	9	56	43,7	3	7	52	28	644	224	205	18
	1710	9	9	42	24,4	3	7	53	34	4	139	830	72

Epochs of the Sun's mean motion.
Mean time under the Meridian of Greenwich Obfervatory.

Gregorian Style.		MeanLong. ☉				Long. Apo.				I. ☽	II. ♃	III. ♀	IV. ☊
		s	°	′	″	s	°	′	″	N.	N.	N.	N.
Years after Chrift.	1711	9	9	28	5,2	3	7	54	40	364	54	455	126
	1712	9	10	12	54,3	3	7	55	46	758	972	82	180
	1713	9	9	58	35,0	3	7	56	52	118	887	707	233
	1714	9	9	44	15,8	3	7	57	58	478	802	332	287
	1715	9	9	29	56,5	3	7	59	4	838	717	957	341
	1716	9	10	14	45,6	3	8	0	10	232	635	584	395
	1717	9	10	0	26,3	3	8	1	16	593	550	209	448
	1718	9	9	46	7,1	3	8	2	22	953	465	834	502
	1719	9	9	31	47,8	3	8	3	28	313	380	459	556
	1720	9	10	16	36,9	3	8	4	34	707	298	86	610
	1721	9	10	2	17,6	3	8	5	40	67	213	711	663
	1722	9	9	47	58,4	3	8	6	46	427	128	336	717
	1723	9	9	33	39,1	3	8	7	52	787	43	961	771
	1724	9	10	18	28,2	3	8	8	58	181	961	588	825
	1725	9	10	4	9,0	3	8	10	4	541	876	213	878
	1726	9	9	49	49,7	3	8	11	10	901	791	838	932
	1727	9	9	35	30,5	3	8	12	16	261	706	463	986
	1728	9	10	20	19,5	3	8	13	22	655	623	90	39
	1729	9	10	6	0,3	3	8	14	28	15	538	715	93
	1730	9	9	51	41,0	3	8	15	34	375	453	340	147
	1731	9	9	37	21,8	3	8	16	40	735	368	965	201
	1732	9	10	22	10,9	3	8	17	46	129	286	592	254
	1733	9	10	7	51,6	3	8	18	52	489	201	217	308
	1734	9	9	53	32,4	3	8	19	58	849	116	842	362
	1735	9	9	39	13,1	3	8	21	4	209	31	468	416
	1736	9	10	24	2,2	3	8	22	10	603	949	95	469
	1737	9	10	9	42,9	3	8	23	16	963	864	720	523
	1738	9	9	55	23,7	3	8	24	22	323	779	345	577
	1739	9	9	41	4,4	3	8	25	28	683	694	970	631
	1740	9	10	25	53,5	3	8	26	34	77	611	597	684
	1741	9	10	11	34,2	3	8	27	40	437	526	222	738
	1742	9	9	57	15,0	3	8	28	46	797	441	847	792
	1743	9	9	42	55,7	3	8	29	52	157	356	472	846
	1744	9	10	27	44,8	3	8	30	58	551	274	99	899
	1745	9	10	13	25,6	3	8	32	4	911	189	724	953
	1746	9	9	59	6,3	3	8	33	10	271	104	349	7
	1747	9	9	44	47,1	3	8	34	16	631	19	974	60
	1748	9	10	29	36,1	3	8	35	22	25	936	601	114
	1749	9	10	15	16,9	3	8	36	28	385	851	226	168
	1750	9	10	0	57,6	3	8	37	34	745	766	851	222
	1751	9	9	46	38,4	3	8	38	40	105	681	476	275
	1752	9	10	31	27,5	3	8	39	46	499	599	103	329
	1753	9	10	17	8,2	3	8	40	52	859	514	728	383
	1754	9	10	2	49,0	3	8	41	58	219	429	353	437
	1755	9	9	48	29,7	3	8	43	4	579	344	978	490
	1756	9	10	33	18,8	3	8	44	10	973	262	605	544
	1757	9	10	18	59,5	3	8	45	16	334	177	230	598
	1758	9	10	4	40,3	3	8	46	22	694	92	855	652
	1759	9	9	50	21,0	3	8	47	28	54	7	480	705
	1760	9	10	35	10,1	3	8	48	34	448	925	107	759
	1761	9	10	20	50,8	3	8	49	40	808	840	732	813
	1762	9	10	6	31,6	3	8	50	46	168	755	357	866
	1763	9	9	52	12,3	3	8	51	52	528	670	982	920
	1764	9	10	37	1,4	3	8	52	58	922	588	609	974
	1765	9	10	22	42,2	3	8	54	4	282	503	234	27
	1766	9	10	8	22,9	3	8	55	10	642	418	359	81
	1767	9	9	54	3,7	3	8	56	16	2	333	484	135
	1768	9	10	38	52,7	3	8	57	22	396	250	111	189
	1769	9	10	24	33,5	3	8	58	28	756	165	736	242
	1770	9	10	10	14,2	3	8	59	34	116	80	361	296
	1771	9	9	55	55,0	3	9	0	40	476	995	986	350
	1772	9	10	40	44,1	3	9	1	46	870	913	613	404

Epochs of the Sun's mean motion for the meridian of Philadelphia.

New Style.		☉ meanLong.				Long. Apog.				I. ☽	II. ♃	III. ♀	IV. ☊
		s	°	′	″	s	°	′	″	N.	N.	N.	N.
Years of	1765	9	10	35	2,8	3	8	54	4	289	504	234	27
Christ.	1766	9	10	20	43,5	3	8	55	10	649	419	859	81
	1767	9	10	6	24,3	3	8	56	16	9	334	484	135
	1768	9	10	51	13,3	3	8	57	22	403	251	111	189
	1769	9	10	36	54,1	3	8	58	28	763	166	736	242
	1770	9	10	22	34,8	3	8	59	34	123	81	361	296
	1771	9	10	8	15,6	3	9	0	40	483	996	986	350
	1772	9	10	53	4,7	3	9	1	46	877	914	613	404
	1773	9	10	38	45,4	3	9	2	52	237	829	238	458
	1774	9	10	24	26,2	3	9	3	58	597	744	863	511
	1775	9	10	10	6,9	3	9	5	4	957	659	488	565
	1776	9	10	54	56,0	3	9	6	10	351	577	115	619
	1777	9	10	40	36,7	3	9	7	16	712	492	740	672
	1778	9	10	26	17,5	3	9	8	22	72	407	365	726
	1779	9	10	11	58,2	3	9	9	28	432	322	990	780
	1780	9	10	56	47,3	3	9	10	34	826	240	617	834
	1781	9	10	42	28,0	3	9	11	40	186	155	242	887
	1782	9	10	28	8,8	3	9	12	46	546	70	867	941
	1783	9	10	13	49,5	3	9	13	52	906	985	492	994
	1784	9	10	58	38,6	3	9	14	58	300	903	119	48
	1785	9	10	44	19,4	3	9	16	4	660	818	744	102
	1786	9	10	30	0,1	3	9	17	10	20	733	369	156
	1787	9	10	15	40,9	3	9	18	16	380	648	994	209
	1788	9	11	0	29,9	3	9	19	22	774	565	621	263
	1789	9	10	46	10,7	3	9	20	28	134	480	246	317
	1790	9	10	31	51,4	3	9	21	34	494	395	871	371
	1791	9	10	17	32,2	3	9	22	40	854	310	496	424
	1792	9	11	2	21,3	3	9	23	46	248	228	123	478
	1793	9	10	48	2,0	3	9	24	52	608	143	748	532
	1794	9	10	33	42,8	3	9	25	58	968	58	373	585
	1795	9	10	19	23,5	3	9	27	4	328	973	998	639
	1796	9	11	4	12,6	3	9	28	10	722	891	625	693
	1797	9	10	49	53,3	3	9	29	16	82	806	250	747
	1798	9	10	35	34,1	3	9	30	22	442	721	875	800
	1799	9	10	21	14,8	3	9	31	28	802	636	500	854
	1800	9	10	6	55,6	3	9	32	34	162	551	125	907
	1801	9	9	52	36,3	3	9	33	40	522	466	750	961
	1802	9	9	38	17,0	3	9	34	46	882	381	375	15
	1803	9	9	23	57,7	3	9	35	52	242	296	0	69
	1804	9	10	8	46,9	3	9	36	58	636	213	627	123
	1805	9	9	54	27,7	3	9	38	4	996	128	252	176
	1806	9	9	40	8,4	3	9	39	10	356	43	877	230
	1807	9	9	25	49,1	3	9	40	16	716	958	502	284
	1808	9	10	10	38,2	3	9	41	22	110	876	129	338
	1809	9	9	56	19,0	3	9	42	28	470	791	755	391
	1810	9	9	41	59,7	3	9	43	34	830	706	380	445
	1811	9	9	27	40,5	3	9	44	40	190	621	5	499
	1812	9	10	12	29,6	3	9	45	46	584	539	632	553
	1813	9	9	58	10,3	3	9	46	52	944	454	257	606
	1814	9	9	43	51,1	3	9	47	58	304	269	882	660
	1815	9	9	29	31,8	3	9	49	4	664	284	507	714
	1816	9	10	14	20,9	3	9	50	10	58	201	134	768
	1817	9	10	0	1,6	3	9	51	16	418	116	759	821
	1818	9	9	45	42,4	3	9	52	22	778	31	384	875
	1819	9	9	31	23,1	3	9	53	28	138	946	09	929
	1820	9	10	16	12,2	3	9	54	34	532	864	636	983
	1821	9	10	1	52,9	3	9	55	40	892	779	261	36
	1822	9	9	47	33,7	3	9	56	46	252	684	886	90
	1823	9	9	33	14,4	3	9	57	52	612	609	511	144
	1824	9	10	18	3,5	3	9	58	58	6	527	138	198
	1825	9	10	3	44,3	3	10	0	4	366	442	763	251
	1826	9	9	49	25,0	3	10	1	10	726	357	388	305

Epochs of the Sun's mean motion for the meridian of Philadelphia.

New Style.		☉ mean Long.				Long. Apo.				I. ☽	II. ♃	III. ♀	IV. ☊
		s	°	′	″	s	°	′	″	N.	N.	N.	N.
Years of	1827	9	9	35	5,8	3	10	2	16	86	272	13	359
Christ.	1828	9	10	19	54,9	3	10	3	22	480	190	640	413
	1829	9	10	5	35,6	3	10	4	28	840	105	265	466
	1830	9	9	51	16,3	3	10	5	34	200	20	890	520
	1831	9	9	36	57,1	3	10	6	40	560	935	515	574
	1832	9	10	21	46,2	3	10	7	46	954	852	142	628
	1833	9	10	7	26,9	3	10	8	52	314	767	767	681
	1834	9	9	53	7,7	3	10	9	58	674	682	392	735

Table of the Sun's mean motion, in Months and Days.

JANUARY.

Days.	Longitude ☉				Apo.	I. ☽	II. ♃	III. ♀	IV. ☊	Pre. Eq.
	s	°	′	″	″	N.	N.	N.	N.	″
1	0	0	59	8,3	0	34	3	2	0	0,1
2	0	1	58	16,7	0	68	5	3	0	0,3
3	0	2	57	25,0	1	102	8	5	0	0,4
4	0	3	56	33,3	1	135	10	7	1	0,6
5	0	4	55	41,7	1	169	13	9	1	0,7
6	0	5	54	50,0	1	203	15	10	1	0,8
7	0	6	53	58,3	1	237	18	12	1	1,0
8	0	7	53	6,6	1	271	20	14	1	1,1
9	0	8	52	15,0	2	305	23	15	1	1,2
10	0	9	51	23,3	2	339	25	17	1	1,4
11	0	10	50	31,6	2	372	28	19	2	1,5
12	0	11	49	40,0	2	406	30	21	2	1,7
13	0	12	48	48,3	2	440	33	22	2	1,8
14	0	13	47	56,6	3	474	35	24	2	1,9
15	0	14	47	5,0	3	508	38	26	2	2,1
16	0	15	46	13,3	3	542	40	27	2	2,2
17	0	16	45	21,6	3	576	43	29	3	2,3
18	0	17	44	30,0	3	610	45	31	3	2,5
19	0	18	43	38,3	3	643	48	33	3	2,6
20	0	19	42	46,6	4	677	50	34	3	2,8
21	0	20	41	54,9	4	710	53	36	3	2,9
22	0	21	41	3,3	4	745	55	38	3	3,0
23	0	22	40	11,6	4	779	58	39	3	3,2
24	0	23	39	19,9	4	813	60	41	4	3,3
25	0	24	38	28,3	5	847	63	43	4	3,4
26	0	25	37	36,6	5	880	65	45	4	3,6
27	0	26	36	44,9	5	914	68	46	4	3,7
28	0	27	35	53,3	5	948	70	48	4	3,9
29	0	28	35	1,6	5	982	73	50	4	4,0
30	0	29	34	9,9	5	16	75	51	4	4,1
31	1	0	33	18,3	6	50	78	53	5	4,3

FEBRUARY.

Days.	Longitude ☉				Apo.	I. ☽	II. ♃	III. ♀	IV. ☊	Pre. Eq.
	s	°	′	″	″	N.	N.	N.	N.	″
1	1	1	32	26,6	6	84	80	55	5	4,4
2	1	2	31	34,9	6	117	83	57	5	4,5
3	1	3	30	43,2	6	151	85	58	5	4,7
4	1	4	29	51,6	6	185	88	60	5	4,8
5	1	5	28	59,9	7	219	90	62	5	5,0
6	1	6	28	8,2	7	253	93	63	5	5,1
7	1	7	27	16,6	7	287	95	65	6	5,2

Table of the Sun's mean motion, In Months and Days.

FEBRUARY.

Days.	Longitude ☉ s	°	′	″	Apo. ″	I. ☽ N.	II. ♃ N.	III. ♀ N.	IV. ☊ N.	Pre. Eq. ″
8	1	8	26	24,9	7	321	98	67	6	5,4
9	1	9	25	33,2	7	355	100	69	6	5,5
10	1	10	24	41,6	7	388	103	70	6	5,6
11	1	11	23	49,9	8	422	105	72	6	5,8
12	1	12	22	58,2	8	456	108	74	6	5,9
13	1	13	22	6,6	8	490	110	75	6	6,1
14	1	14	21	14,9	8	524	113	77	7	6,2
15	1	15	20	23,2	8	558	115	79	7	6,3
16	1	16	19	31,5	8	592	118	80	7	6,5
17	1	17	18	39,9	9	625	120	82	7	6,6
18	1	18	17	48,2	9	659	123	84	7	6,7
19	1	19	16	56,5	9	693	125	86	7	6,9
20	1	20	16	4,9	9	727	128	87	8	7,0
21	1	21	15	13,2	9	761	130	89	8	7,2
22	1	22	14	21,5	10	795	133	91	8	7,3
23	1	23	13	29,9	10	829	135	92	8	7,4
24	1	24	12	38,2	10	862	138	94	8	7,6
25	1	25	11	46,5	10	896	140	96	8	7,7
26	1	26	10	54,9	10	930	143	98	8	7,8
27	1	27	10	3,2	11	964	145	99	9	8,0
28	1	28	9	11,5	11	998	148	101	9	8,1

MARCH.

Days.	Longitude ☉ s	°	′	″	Apo. ″	I. ☽ N.	II. ♃ N.	III. ♀ N.	IV. ☊ N.	Pre. Eq. ″
1	1	29	8	19,8	11	32	150	103	9	8,3
2	2	0	7	28,2	11	66	153	104	9	8,4
3	2	1	6	36,5	11	100	155	106	9	8,5
4	2	2	5	44,8	11	133	158	108	9	8,7
5	2	3	4	53,2	12	167	160	110	9	8,8
6	2	4	4	1,5	12	201	163	111	10	9,0
7	2	5	3	9,8	12	235	165	113	10	9,1
8	2	6	2	18,2	12	269	168	115	10	9,2
9	2	7	1	26,5	12	303	170	116	10	9,4
10	2	8	0	34,8	13	337	173	118	10	9,5
11	2	8	59	43,2	13	370	175	120	10	9,6
12	2	9	58	51,5	13	404	178	122	10	9,8
13	2	10	57	59,8	13	438	181	123	11	9,9
14	2	11	57	8,1	13	472	183	125	11	10,1
15	2	12	56	16,5	13	506	186	127	11	10,2
16	2	13	55	24,8	14	540	188	128	11	10,3
17	2	14	54	33,1	14	574	191	130	11	10,5
18	2	15	53	41,5	14	607	193	132	11	10,6
19	2	16	52	49,8	14	641	196	134	11	10,7
20	2	17	51	58,1	14	675	198	135	12	10,9
21	2	18	51	6,5	15	709	201	137	12	11,0
22	2	19	50	14,8	15	743	203	139	12	11,2
23	2	20	49	23,1	15	777	206	140	12	11,3
24	2	21	48	31,5	15	811	208	142	12	11,4
25	2	22	47	39,8	15	844	211	144	12	11,6
26	2	23	46	48,1	15	878	213	146	13	11,7
27	2	24	45	56,4	16	912	216	147	13	11,8
28	2	25	45	4,8	16	946	218	149	13	12,0
29	2	26	44	13,1	16	980	221	151	13	12,1
30	2	27	43	21,4	16	14	223	152	13	12,3
31	2	28	42	29,8	16	48	226	154	13	12,4

Table of the Sun's mean motion, In Months and Days.

APRIL.

Days.	Longitude ☉ s	°	′	″	Apo. ″	I. ☽ N.	II. ♃ N.	III. ♀ N.	IV. ☊ N.	Pre. Eq. ″
1	2	29	41	38,1	16	82	228	156	13	12,5
2	3	0	40	46,4	16	115	231	158	14	12,7
3	3	1	39	54,8	17	149	233	159	14	12,8
4	3	2	39	3,1	17	183	236	161	14	12,9
5	3	3	38	11,4	17	217	238	163	14	13,1
6	3	4	37	19,8	17	251	241	164	14	13,2
7	3	5	36	28,1	17	285	243	166	14	13,4
8	3	6	35	36,4	18	319	246	168	14	13,5
9	3	7	34	44,8	18	352	248	170	15	13,6
10	3	8	33	53,1	18	386	251	171	15	13,8
11	3	9	33	1,4	18	420	253	173	15	13,9
12	3	10	32	9,7	18	454	256	175	15	14,0
13	3	11	31	18,1	19	488	258	176	15	14,2
14	3	12	30	26,4	19	522	261	178	15	14,3
15	3	13	29	34,7	19	556	263	180	15	14,5
16	3	14	28	43,1	19	589	266	182	16	14,6
17	3	15	27	51,4	19	623	268	183	16	14,7
18	3	16	26	59,7	20	657	271	185	16	14,9
19	3	17	26	8,1	20	691	273	187	16	15,0
20	3	18	25	16,4	20	725	275	188	16	15,1
21	3	19	24	24,7	20	759	278	190	16	15,3
22	3	20	23	33,1	20	793	281	192	16	15,4
23	3	21	22	41,4	20	827	283	194	17	15,6
24	3	22	21	49,7	21	860	286	195	17	15,7
25	3	23	20	58,0	21	894	288	197	17	15,8
26	3	24	20	6,4	21	928	291	199	17	16,0
27	3	25	19	14,7	21	962	293	200	17	16,1
28	3	26	18	23,0	21	996	296	202	17	16,2
29	3	27	17	31,4	22	30	298	204	18	16,4
30	3	28	16	39,7	22	64	301	206	18	16,5

MAY.

Days.	Longitude ☉ s	°	′	″	Apo. ″	I. ☽ N.	II. ♃ N.	III. ♀ N.	IV. ☊ N.	Pre. Eq. ″
1	3	29	15	48,0	22	97	303	207	18	16,7
2	4	0	14	56,4	22	131	306	209	18	16,8
3	4	1	14	4,7	22	165	308	211	18	16,9
4	4	2	13	13,0	22	199	311	212	18	17,1
5	4	3	12	21,4	23	233	313	214	18	17,2
6	4	4	11	29,7	23	267	316	216	19	17,4
7	4	5	10	38,0	23	301	318	217	19	17,5
8	4	6	9	46,3	23	334	321	218	19	17,6
9	4	7	8	54,7	23	368	323	221	19	17,8
10	4	8	8	3,0	24	402	326	223	19	17,9
11	4	9	7	11,3	24	436	328	224	19	18,0
12	4	10	6	19,7	24	470	331	226	19	18,2
13	4	11	5	28,0	24	504	333	228	20	18,3
14	4	12	4	36,3	24	538	336	229	20	18,5
15	4	13	3	44,7	24	572	338	231	20	18,6
16	4	14	2	53,0	25	605	341	233	20	18,7
17	4	15	2	1,3	25	639	343	235	20	18,9
18	4	16	1	9,7	25	673	346	236	20	19,0
19	4	17	0	18,0	25	707	348	238	20	19,1
20	4	17	59	26,3	25	741	351	240	21	19,3
21	4	18	58	34,6	25	775	353	241	21	19,4
22	4	19	57	43,0	26	809	356	243	21	19,6
23	4	20	56	51,3	26	842	359	245	21	19,7
24	4	21	55	59,6	26	876	361	247	21	19,8

Table of the Sun's mean motion,
In Months and Days.

MAY.

Days.	Longitude ☉ s	°	′	″	Apo. ″	I. ☽ N.	II. ♃ N.	III. ♀ N.	IV. ☊ N.	Pre. Eq. ″
25	4	22	55	8,0	26	910	364	248	21	20,0
26	4	23	54	16,3	26	944	366	250	21	20,1
27	4	24	53	24,6	27	978	369	252	22	20,2
28	4	25	52	33,0	27	12	371	253	22	20,4
29	4	26	51	41,3	27	46	374	255	22	20,5
30	4	27	50	49,6	27	79	376	257	22	20,7
31	4	28	49	58,0	27	113	379	259	22	20,8

JUNE.

Days.	Longitude ☉ s	°	′	″	Apo. ″	I. ☽ N.	II. ♃ N.	III. ♀ N.	IV. ☊ N.	Pre. Eq. ″
1	4	29	49	6,3	27	147	381	260	22	20,9
2	5	0	48	14,6	28	181	384	262	23	21,1
3	5	1	47	22,9	28	215	386	264	23	21,2
4	5	2	46	31,3	28	249	389	265	23	21,3
5	5	3	45	39,6	28	283	391	267	23	21,5
6	5	4	44	47,9	28	317	394	269	23	21,6
7	5	5	43	56,3	29	350	396	271	23	21,8
8	5	6	43	4,6	29	384	399	272	23	21,9
9	5	7	42	12,9	29	418	401	274	24	22,0
10	5	8	41	21,3	29	452	404	276	24	22,2
11	5	9	40	29,6	29	486	406	277	24	22,3
12	5	10	39	37,9	30	520	409	279	24	22,4
13	5	11	38	46,3	30	554	411	281	24	22,6
14	5	12	37	54,6	30	587	414	283	24	22,7
15	5	13	37	2,9	30	621	416	284	24	22,9
16	5	14	36	11,2	30	655	419	286	25	23,0
17	5	15	35	19,6	30	689	421	288	25	23,1
18	5	16	34	27,9	31	723	424	289	25	23,3
19	5	17	33	36,2	31	757	426	291	25	23,4
20	5	18	32	44,6	31	791	429	293	25	23,5
21	5	19	31	52,9	31	824	431	295	25	23,7
22	5	20	31	1,2	31	858	434	296	25	23,8
23	5	21	30	9,6	31	892	436	298	26	24,0
24	5	22	29	17,9	32	926	439	300	26	24,1
25	5	23	28	26,2	32	960	441	301	26	24,2
26	5	24	27	34,6	32	994	444	303	26	24,4
27	5	25	26	42,9	32	28	446	305	26	24,5
28	5	26	25	51,2	32	62	448	307	26	24,6
29	5	27	24	59,5	33	95	451	308	26	24,8
30	5	28	24	7,9	33	129	454	310	27	24,9

JULY.

Days.	Longitude ☉ s	°	′	″	Apo. ″	I. ☽ N.	II. ♃ N.	III. ♀ N.	IV. ☊ N.	Pre. Eq. ″.
1	5	29	23	16,2	33	163	456	312	27	25,1
2	6	0	22	24,5	33	197	459	313	27	25,2
3	6	1	21	32,9	33	231	461	315	27	25,3
4	6	2	20	41,2	33	265	464	317	27	25,5
5	6	3	19	49,5	34	299	466	319	27	25,6
6	6	4	18	57,9	34	332	469	320	28	25,8
7	6	5	18	6,2	34	366	471	322	28	25,9
8	6	6	17	14,5	34	400	474	324	28	26,0
9	6	7	16	22,9	34	434	476	325	28	26,2
10	6	8	15	31,2	35	468	479	327	28	26,3
11	6	9	14	39,5	35	502	481	329	28	26,4

Table of the Sun's mean motion,
In Months and Days.

JULY.

Days.	Longitude ☉ s	°	′	″	Apo. ″	I. ☽ N.	II. ♃ N.	III. ♀ N.	IV. ☊ N.	Pre. Eq. ″
12	6	10	13	47,8	35	536	484	331	28	26,6
13	6	11	12	56,2	35	569	486	332	29	26,7
14	6	12	12	4,5	35	603	489	334	29	26,9
15	6	13	11	12,8	35	637	491	336	29	27,0
16	6	14	10	21,2	36	671	494	337	29	27,1
17	6	15	9	29,5	36	705	496	339	29	27,3
18	6	16	8	37,8	36	739	499	341	29	27,4
19	6	17	7	46,2	36	773	501	343	29	27,5
20	6	18	6	54,5	36	806	504	344	30	27,7
21	6	19	6	2,8	37	840	506	346	30	27,8
22	6	20	5	11,2	37	874	509	348	30	28,0
23	6	21	4	19,5	37	908	511	349	30	28,1
24	6	22	3	27,8	37	942	514	351	30	28,2
25	6	23	2	36,1	37	976	516	353	30	28,4
26	6	24	1	44,5	37	10	519	354	30	28,5
27	6	25	0	52,8	38	44	521	356	31	28,6
28	6	26	0	1,1	38	77	524	358	31	28,8
29	6	26	59	9,5	38	111	526	360	31	28,9
30	6	27	58	17,8	38	145	529	361	31	29,1
31	6	28	57	26,1	38	179	531	363	31	29,2

Table of the Sun's mean motion,
In Months and Days.

AUGUST.

Days.	Longitude ☉ s	°	′	″	Apo. ″	I. ☽ N.	II. ♃ N.	III. ♀ N.	IV. ☊ N.	Pre. Eq. ″
1	6	29	56	34,5	39	213	534	365	31	29,3
2	7	0	55	42,8	39	247	536	366	31	29,5
3	7	1	54	51,1	39	281	539	368	32	29,6
4	7	2	53	59,5	39	314	542	370	32	29,7
5	7	3	53	7,8	39	348	544	372	32	29,9
6	7	4	52	16,1	39	382	547	373	32	30,0
7	7	5	51	24,4	40	416	549	375	32	30,2
8	7	6	50	32,8	40	450	552	377	32	30,3
9	7	7	49	41,1	40	484	554	378	33	30,4
10	7	8	48	49,4	40	518	557	380	33	30,6
11	7	9	47	57,8	40	551	559	382	33	30,7
12	7	10	47	6,1	41	585	562	384	33	30,8
13	7	11	46	14,4	41	619	564	385	33	31,0
14	7	12	45	22,8	41	653	567	387	33	31,1
15	7	13	44	31,1	41	687	569	389	33	31,3
16	7	14	43	39,4	41	721	572	390	34	31,4
17	7	15	42	47,8	41	755	574	392	34	31,5
18	7	16	41	56,1	42	789	577	394	34	31,7
19	7	17	41	4,4	42	822	579	396	34	31,8
20	7	18	40	12,7	42	856	582	397	34	31,9
21	7	19	39	21,1	42	890	584	399	34	32,1
22	7	20	38	29,4	42	924	587	401	34	32,2
23	7	21	37	37,7	43	958	589	402	35	32,4
24	7	22	36	46,1	43	992	592	404	35	32,5
25	7	23	35	54,4	43	26	594	406	35	32,6
26	7	24	35	2,7	43	59	597	408	35	32,8
27	7	25	34	11,1	43	93	599	409	35	32,9
28	7	26	33	19,4	43	127	602	411	35	33,1
29	7	27	32	27,7	44	161	604	413	35	33,2
30	7	28	31	36,1	44	195	607	414	36	33,3
31	7	29	30	44,4	44	229	609	416	36	33,5

Table of the Sun's mean motion,
In Months and Days.

SEPTEMBER.

Days.	Longitude ☉ s	°	′	″	Apo. ″	I. ☽ N.	II. ♃ N.	III. ♀ N.	IV. ☊ N.	Pre. Eq. ″
1	8	0	29	52,7	44	263	612	418	36	33,6
2	8	1	29	1,0	44	296	614	420	36	33,7
3	8	2	28	9,4	44	330	617	421	36	33,9
4	8	3	27	17,7	45	364	619	423	36	34,0
5	8	4	26	26,0	45	398	622	425	36	34,2
6	8	5	25	34,4	45	432	624	426	37	34,3
7	8	6	24	42,7	45	466	627	428	37	34,4
8	8	7	23	51,0	45	500	629	430	37	34,6
9	8	8	22	59,4	45	534	632	432	37	34,7
10	8	9	22	7,7	46	567	634	433	37	34,8
11	8	10	21	16,0	46	601	637	435	37	35,0
12	8	11	20	24,4	46	635	639	437	38	35,1
13	8	12	19	32,7	46	669	642	438	38	35,3
14	8	13	18	41,0	46	703	644	440	38	35,4
15	8	14	17	49,4	47	737	647	442	38	35,5
16	8	15	16	57,7	47	771	649	444	38	35,7
17	8	16	16	6,0	47	804	652	445	38	35,8
18	8	17	15	14,3	47	838	654	447	38	35,9
19	8	18	14	22,7	47	872	657	449	39	36,1
20	8	19	13	31,0	48	906	659	450	39	36,2
21	8	20	12	39,3	48	940	662	452	39	36,4
22	8	21	11	47,7	48	974	664	454	39	36,5
23	8	22	10	56,0	48	8	667	456	39	36,6
24	8	23	10	4,3	48	41	669	457	39	36,8
25	8	24	9	12,7	48	75	672	459	39	36,9
26	8	25	8	21,0	49	109	674	461	40	37,0
27	8	26	7	29,3	49	143	677	462	40	37,2
28	8	27	6	37,7	49	177	679	464	40	37,3
29	8	28	5	46,0	49	211	682	466	40	37,5
30	8	29	4	54,3	49	245	684	468	40	37,6

OCTOBER.

Days.	Longitude ☉ s	°	′	″	Apo. ″	I. ☽ N.	II. ♃ N	III. ♀ N.	IV. ☊ N.	Pre. Eq. ″
1	9	0	4	2,6	50	279	687	469	40	37,8
2	9	1	3	11,0	50	312	689	471	40	37,9
3	9	2	2	19,3	50	346	692	473	41	38,0
4	9	3	1	27,6	50	380	694	474	41	38,1
5	9	4	0	36,0	50	414	697	476	41	38,3
6	9	4	59	44,3	50	448	699	478	41	38,4
7	9	5	58	52,6	51	482	702	480	41	38,6
8	9	6	58	1,0	51	516	704	481	41	38,7
9	9	7	57	9,3	51	549	707	483	41	38,8
10	9	8	56	17,6	51	583	709	485	42	39,0
11	9	9	55	26,0	51	617	712	486	42	39,1
12	9	10	54	34,3	52	651	714	488	42	39,2
13	9	11	53	42,6	52	685	717	490	42	39,4
14	9	12	52	50,9	52	719	720	491	42	39,5
15	9	13	51	59,3	52	753	722	493	42	39,7
16	9	14	51	7,6	52	786	725	495	43	39,8
17	9	15	50	15,9	52	820	727	497	43	39,9
18	9	16	49	24,3	53	854	730	498	43	40,1
19	9	17	48	32,6	53	888	732	500	43	40,2
20	9	18	47	40,9	53	922	735	502	43	40,3
21	9	19	46	49,3	53	956	737	503	43	40,5
22	9	20	45	57,6	53	990	740	505	43	40,6
23	9	21	45	5,9	53	24	742	507	44	40,8
24	9	22	44	14,3	54	57	745	509	44	40,9
25	9	23	43	22,6	54	91	747	510	44	41,0
26	9	24	41	30,9	54	124	750	512	44	41,2
27	9	25	41	39,2	54	159	752	514	44	41,3
28	9	26	40	47,6	54	193	755	515	44	41,5
29	9	27	39	55,9	55	227	757	517	44	41,6
30	9	28	39	4,2	55	261	760	519	45	41,7
31	9	29	38	12,6	55	294	762	521	45	41,9

Table of the Sun's mean motion,
In Months and Days.

NOVEMBER.

Days.	Longitude ☉ s	°	′	″	Apo. ′	″	I. ☽ N.	II. ♃ N.	III. ♀ N.	IV. ☊ N.	Pre. Eq. ″
1	10	0	37	20,9		55	328	765	522	45	42,0
2	10	1	36	29,2		55	362	767	524	45	42,1
3	10	2	35	37,6		55	396	770	526	45	42,3
4	10	3	34	45,9		56	430	772	527	45	42,4
5	10	4	33	54,2		56	464	775	529	45	42,6
6	10	5	33	2,6		56	498	777	531	46	42,7
7	10	6	32	10,9		56	531	780	533	46	42,8
8	10	7	31	19,2		56	565	782	534	46	43,0
9	10	8	30	27,5		57	599	785	536	46	43,1
10	10	9	29	35,9		57	633	787	538	46	43,2
11	10	10	28	44,2		57	667	790	539	46	43,4
12	10	11	27	52,5		57	701	792	541	46	43,5
13	10	12	27	0,9		57	735	795	543	47	43,7
14	10	13	26	9,2		58	768	797	545	47	43,8
15	10	14	25	17,5		58	802	800	546	47	43,9
16	10	15	24	25,9		58	836	802	548	47	44,1
17	10	16	23	34,2		58	870	805	550	47	44,2
18	10	17	22	42,5		58	904	807	551	47	44,3
19	10	18	21	50,9		58	938	810	553	48	44,5
20	10	19	20	59,2		59	972	812	555	48	44,6
21	10	20	20	7,5		59	6	815	557	48	44,8
22	10	21	19	15,8		59	39	817	558	48	44,9
23	10	22	18	24,2		59	73	820	560	48	45,0
24	10	23	17	32,5		59	107	822	562	48	45,2
25	10	24	16	40,8	1	0	141	825	563	48	45,3
26	10	25	15	49,2	1	0	175	827	565	49	45,4
27	10	26	14	57,5	1	0	209	830	567	49	45,6
28	10	27	14	5,8	1	0	243	832	569	49	45,7
29	10	28	13	14,2	1	0	276	835	570	49	45,9
30	10	29	12	22,5	1	0	310	837	572	49	46,0

DECEMBER.

Days.	Longitude ☉ s	°	′	″	Apo. ′	″	I. ☽ N.	II. ♃ N.	III. ♀ N.	IV. ☊ N.	Pre. Eq. ″
1	11	0	11	30,8	1	1	344	840	574	49	46,1
2	11	1	10	39,2	1	1	378	842	575	49	46,3
3	11	2	9	47,5	1	1	412	845	577	50	46,4
4	11	3	8	55,8	1	1	446	847	579	50	46,5
5	11	4	8	4,1	1	1	480	850	581	50	46,7
6	11	5	7	12,5	1	1	513	852	582	50	46,8
7	11	6	6	20,8	1	2	547	855	584	50	47,0
8	11	7	5	29,1	1	2	581	857	586	50	47,1
9	11	8	4	37,5	1	2	615	860	587	50	47,2
10	11	9	3	45,8	1	2	649	862	589	51	47,4
11	11	10	2	54,1	1	2	683	865	591	51	47,5
12	11	11	2	2,5	1	3	717	867	593	51	47,6
13	11	12	1	10,8	1	3	751	870	594	51	47,8
14	11	13	0	19,1	1	3	784	872	596	51	47,9
15	11	13	59	27,5	1	3	818	875	598	51	48,1
16	11	14	58	35,8	1	3	852	877	599	51	48,2
17	11	15	57	44,1	1	3	886	880	601	52	48,3
18	11	16	56	52,4	1	4	920	882	603	52	48,5
19	11	17	56	0,8	1	4	954	885	605	52	48,6
20	11	18	55	9,1	1	4	988	887	606	52	48,7
21	11	19	54	17,4	1	4	21	890	608	52	48,9
22	11	20	53	25,8	1	4	55	892	610	52	49,0
23	11	21	52	34,1	1	5	89	895	611	53	49,2
24	11	22	11	42,4	1	5	123	898	613	53	49,3
25	11	23	50	50,8	1	5	157	900	615	53	49,4
26	11	24	49	59,1	1	5	191	903	617	53	49,6
27	11	25	49	7,4	1	5	225	905	618	53	49,7
28	11	26	48	15,8	1	5	258	908	620	53	45,9
29	11	27	47	24,1	1	6	292	910	622	53	50,0
30	11	28	46	32,4	1	6	326	913	623	54	50,1
31	11	29	45	40,7	1	6	360	915	625	54	50,3

Table of the Sun's mean motion, in Hours and Minutes.

In Hours.					In Minutes.				In Seconds.			
	Lon. ☉	I. ☽	II. ♃	III. ♀		Lo. ☉		Lo. ☉		L. ☉		L. ☉
h	′ ″	N.	N.	N.	′	′ ″	′	′ ″	″	″	″	″
1	2 27,8	1	0	0	1	0 2,5	31	1 16,4	1	0,0	31	1,3
2	4 55,7	3	0	0	2	0 4,9	32	1 18,8	2	0,1	32	1,3
3	7 23,5	4	0	0	3	0 7,4	33	1 21,3	3	0,1	33	1,4
4	9 51,4	6	0	0	4	0 9,9	34	1 23,8	4	0,2	34	1,4
5	12 19,2	7	1	0	5	0 12,3	35	1 26,2	5	0,2	35	1,4
6	14 47,1	8	1	0	6	0 14,8	36	1 28,7	6	0,2	36	1,5
7	17 14,9	10	1	0	7	0 17,2	37	1 31,2	7	0,3	37	1,5
8	19 42.8	11	1	1	8	0 19,7	38	1 33,6	8	0,3	38	1,6
6	22 10,6	13	1	1	9	0 22,2	39	1 36,1	9	0,4	39	1,6
10	24 38,5	14	1	1	10	0 24,6	40	1 38,6	10	0,4	40	1,6
11	27 6,3	16	1	1	11	0 27,1	41	1 41,0	11	0,5	41	1,7
12	29 34,2	17	1	1	12	0 29,6	42	1 43,5	12	0,5	42	1,7
13	32 2,0	18	1	1	13	0 32,0	43	1 46,0	13	0,5	43	1,8
14	34 29,9	20	1	1	14	0 34,5	44	1 48,4	14	0,6	44	1,8
15	36 57,7	21	2	1	15	0 37,0	45	1 50,9	15	0,6	45	1,8
16	39 25,6	23	2	1	16	0 39,4	46	1 54,3	16	0,7	46	1,9
17	41 53,4	24	2	1	17	0 41,9	47	1 55,8	17	0,7	47	1,9
18	44 21,2	25	2	1	18	0 44,4	48	1 58,3	18	0,7	48	2,0
19	46 49,1	27	2	1	19	0 46,8	49	2 0,7	19	0,8	49	2,0
20	49 16,9	28	2	1	20	0 49,3	50	2 3,2	20	0,8	50	2,1
21	51 44,8	30	2	1	21	0 51,7	51	2 5,7	21	0,9	51	2,1
22	54 12,6	31	2	2	22	0 54,2	52	2 8,1	22	0,9	52	2,1
23	56 40,5	32	2	2	23	0 56,7	53	2 10,6	23	0,9	53	2,2
24	59 8,3	34	3	2	24	0 59,1	54	2 13,1	24	1,0	54	2,2
					25	1 1,6	55	2 15,5	25	,0	55	2,3
					26	1 4,1	56	2 18,0	26	1,1	56	2,3
					27	1 6,5	57	2 20,4	27	1,1	57	2,3
					28	1 9,0	58	2 22,9	28	1,1	58	2,4
					29	1 11,5	59	2 25,4	29	1,2	59	2,4
					30	1 13,9	60	2 27,8	30	1,2	60	2,5

For the Sun's Longitude. Equation of the Centre.

Equation of the Sun's Centre in the Elliptical Hypothesis.

Argu. ☉ mean Longit. —— Longit. ☉ Apogee.

S.	0		1		2		S.
	——	Diff.	——	Diff.	——	Diff.	
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	°
0	0 0 0,0	1 58,6	0 56 43,5	1 43,1	1 38 59,5	1 0,8	30
1	0 1 58,6	1 58,4	0 58 26,6	1 42,0	1 40 0,3	0 59,0	29
2	0 3 57,0	1 58,4	1 0 8,6	1 40,9	1 40 59,3	0 57,3	28
3	0 5 55,4	1 58,2	1 1 49,5	1 39,9	1 41 56,6	0 55,5	27
4	0 7 53,6	1 58,2	1 3 29,4	1 38,7	1 42 52,1	0 53,6	26
5	0 9 51,8	1 58,0	1 5 8,1	1 37,6	1 43 45,7	0 51,7	25
6	0 11 49,8	1 57,7	1 6 45,7	1 36,5	1 44 37,4	0 50,0	24
7	0 13 47,5	1 57,5	1 8 22,2	1 35,2	1 45 27,4	0 48,0	23
8	0 15 45,0	1 57,3	1 9 57,4	1 34,2	1 46 15,4	0 46,2	22
9	0 17 42,3	1 57,0	1 11 31,6	1 32,8	1 47 1,6	0 44,2	21
10	0 19 39,3	1 56,7	1 13 4,4	1 31,6	1 47 45,8	0 42,3	20
11	0 21 36,0	1 56,3	1 14 36,0	1 30,2	1 48 28,1	0 40,3	19
12	0 23 32,3	1 55,7	1 16 6,2	1 29,0	1 49 8,4	0 38,5	18
13	0 25 28,0	1 55,3	1 17 35,2	1 27,6	1 49 46,9	0 36,6	17
14	0 27 23,3	1 54,9	1 19 2,8	1 26,2	1 50 23,5	0 34,4	16
15	0 29 18,2	1 54,4	1 20 29,0	1 24,8	1 50 57,9	0 32,4	15
16	0 31 12,6	1 54,0	1 21 53,8	1 23,4	1 51 30,3	0 30,5	14
17	0 33 6,6	1 53,4	1 23 17,2	1 21,8	1 52 0,8	0 28,5	13
18	0 35 0,0	1 52,7	1 24 39,0	1 20,5	1 52 29,3	0 26,4	12
19	0 36 52,7	1 52,1	1 25 59,5	1 18,9	1 52 55,7	0 24.4	11
20	0 38 44,8	1 51,5	1 27 18,4	1 17,4	1 53 20,1	0 22 4	10
21	0 40 36,3	1 50,6	1 28 35,8	1 15,8	1 53 42,5	0 20,3	9
22	0 42 26,9	1 49,9	1 29 51,6	1 14,3	1 54 2,8	0 18,3	8
23	0 44 16,8	1 49,2	1 31 5,9	1 12,6	1 54 21,1	0 16,2	7
24	0 46 6,0	1 48,5	1 32 18,5	1 11,0	1 54 37,3	0 14,0	6
25	0 47 54,5	1 47,6	1 33 29,5	1 9,4	1 54 51,3	0 12,0	5
26	0 49 42,1	1 46,8	1 34 38.9	1 7,7	1 55 3,3	0 9,9	4
27	0 51 28,9	1 45,8	1 35 46,6	1 6,1	1 55 13,2	0 7,7	3
28	0 53 14,7	1 44,8	1 36 52,7	1 4,3	1 55 20,9	0 5,6	2
29	0 54 59,5	1 44,0	1 37 57,0	1 2,5	1 55 26,5	0 3,6	1
30	0 56 43,5		1 38 59,5		1 55 30,1		0
	+		+		+		
	11		10		9		

For the Sun's Longitude. Equation of the Center.

Equation of the Sun's Center in the Elliptical Hypothesis.

Argu. ☉ mean Longit. —— Longit. ☉ Apogee.

S.	3		4		5		S.
	——	Diff.	——	Diff.	——	Diff.	
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	°
0	1 55 30,1	0 1,5	1 41 5,6	1 0,1	0 58 49,7	1 46,6	30
1	1 55 31,6	0 0,6	1 40 5,5	1 2,0	0 57 3,1	1 47,7	29
2	1 55 31,0	0 2,7	1 39 3,5	1 3,9	0 55 15,4	1 48,8	28
3	1 55 28,3	0 4,9	1 37 59,6	1 5,8	0 53 26,6	1 49,8	27
4	1 55 23,4	0 6,9	1 36 53,8	1 7,5	0 51 36,8	1 50,8	26
5	1 55 16,5	0 9,1	1 35 46,3	1 9,3	0 49 46,0	1 51,7	25
6	1 55 7,4	0 11,2	1 34 37,0	1 11,2	0 47 54,3	1 52,7	24
7	1 54 56,2	0 13,3	1 33 25,8	1 12,9	0 46 1,6	1 53,6	23
8	1 54 42,9	0 15,5	1 32 12,9	1 14,7	0 44 8,0	1 54,5	22
9	1 54 27,4	0 17,7	1 30 58,2	1 16,4	0 42 13,5	1 55,2	21
10	1 54 9,7	0 19,6	1 29 41,8	1 18,1	0 40 18,3	1 56,0	20
11	1 53 50,1	0 21,7	1 28 23,7	1 19,8	0 38 22,3	1 56,9	19
12	1 53 28,4	0 23,9	1 27 3,9	1 21,4	0 36 25,4	1 57,8	18
13	1 53 4,5	0 25,9	1 25 42,5	1 23,1	0 34 27,9	1 58,2	17
14	1 52 38,6	0 28,0	1 24 19,4	1 24,8	0 32 29,7	1 58,7	16
15	1 52 10,6	0 30,1	1 22 54,6	1 26,3	0 30 31,0	1 59,4	15
16	1 51 40,5	0 32,2	1 21 28,3	1 27,8	0 28 31,6	1 59,9	14
17	1 51 8,3	0 34,3	1 20 0,5	1 29,4	0 26 31,7	2 0,5	13
18	1 50 34,0	0 36,4	1 18 31,1	1 30,9	0 24 31;2	2 0,9	12
19	1 49 57;6	0 38,3	1 17 0,2	1 32,4	0 22 30,3	2 1,3	11
20	1 49 19,3	0 40,4	1 15 27,8	1 33,9	0 20 29,0	2 1,8	10
21	1 48 38,9	0 42,5	1 13 53,9	1 35,1	0 18 27,2	2 2,2	9
22	1 47 56,4	0 44,4	1 12 18,8	1 36,6	0 16 25,0	2 2,4	8
23	1 47 12,0	0 46,5	1 10 42,2	1 38,0	0 14 22,6	2 2,6	7
24	1 46 25,5	0 48,3	1 9 4,2	1 39,3	0 12 20,0	2 3,0	6
25	1 45 37,2	0 50,5	1 7 24,9	1 40,6	0 10 17,0	2 3,1	5
26	1 44 46,7	0 52,3	1 5 44,3	1 41,8	0 8 13,9	2 3,3	4
27	1 43 54,4	0 54,4	1 4 2,5	1 43,1	0 6 10,6	2 3,4	3
28	1 43 0,0	0 56,3	1 2 19,4	1 44,3	0 4 7,2	2 3,6	2
29	1 42 3,7	0 58,1	1 0 35,1	1 45,4	0 2 3,6	2 3,6	1
30	1 41 5,6		0 58 49,7		0 0 0,0		0
	+		+		+		
	8		7		6		

For the ☉ Lon. Equa. of ☽

Arg. Num. I. ☽.

	0	100	200	300	400	
	+	+	+	+	+	
N.	″	″	″	″	″	N.
0	0,0	4,7	7,6	7,6	4,7	100
10	0,5	5,1	7,7	7,4	4,3	90
20	1,0	5,5	7,9	7,2	3,9	80
30	1,5	5,8	7,9	7,0	3,4	70
40	2,0	6,2	8,0	6,8	2,9	60
50	2,5	6,5	8,0	6,5	2,5	50
60	2,9	6,8	8,0	6,2	2,0	40
70	3,4	7,0	7,9	5,8	1,5	30
80	3,9	7,2	7,9	5,5	1,0	20
90	4,3	7,4	7,7	5,1	0,5	10
100	4,7	7,6	7,6	4,7	0,0	0
	—	—	—	—	—	
	900	800	700	600	500	

For the ☉ Lon. Equa. of ♃

Arg. Num. II. ♃.

	0	100	200	300	400	
	+	+	+	+	+	
N.	″	″	″	″	″	N.
0	0,0	5,6	7,5	5,3	2,2	100
10	0,6	6,1	7,3	4,9	1,9	90
20	1,2	6,4	7,2	4,6	1,7	80
30	1,8	6,6	7,0	4,3	1,4	70
40	2,5	6,9	6,8	4,0	1,2	60
50	3,1	7,1	6,7	3,6	1,0	50
60	3,7	7,3	6,5	3,3	0,8	40
70	4,2	7,4	6,2	3,0	0,6	30
80	4,7	7,4	5,9	2,8	0,4	20
90	5,2	7,5	5,5	2,5	0,2	10
100	5,6	7,5	5,3	2,2	0,0	0
	—	—	—	—	—	
	900	800	700	600	500	

For the ☉ Lon. Equa. of ♀.

Arg. Num. III. ♀.

	0	100	200	300	400	
	—	∓	+	+	+	
N.	″	″	″	″	″	N.
0	0,0	2,0	1,5	5,5	5,1	100
10	0,4	1,9	2,0	5,7	4,7	90
20	0,7	1,7	2,5	5,9	4,3	80
30	1,1	1,5	3,0	6,0	3,9	70
40	1,4	1,2	3,5	6,0	3,4	60
50	1,6	0,8	3,9	6,0	2,9	50
60	1,8	0,4	4,3	5,9	2,4	40
70	2,0	0,0	4,7	5,8	1,8	30
80	2,1	0,5	5,0	5,6	1,2	20
90	2,1	1,0	5,3	5,4	0,6	10
100	2,0	1,5	5,5	5,1	0,0	0
	+	±	—	—	—	
	900	800	700	600	500	

Of a Point in the Equinoctial.

Arg. Num. IV. ☊.

	0	100	200	300	400	
	+	+	+	+	+	
N.	′	″	″	″	″	N.
0	0,0	10,6	17,1	17,1	10,6	100
10	1,2	11,5	17,4	16,7	9,7	90
20	2,3	12,3	17,7	16,3	8,7	80
30	3,4	13,1	17,9	15,8	7,7	70
40	4,5	13,9	18,0	15,2	6,6	60
50	5,6	14,6	18,0	14,6	5,6	50
60	6,6	15,2	18,0	13,9	4,5	40
70	7,7	15,8	17,9	13,1	3,4	30
80	8,7	16,3	17,7	12,3	2,3	20
90	9,7	16,7	17,4	11,5	1,2	10
100	10,6	17,1	17,1	10,6	0,0	0
	—	—	—	—	—	
	900	800	700	600	500	

For the Logarithm of the Sun's distance from the Earth.

Logarithm of the Sun's distance from the earth in the Elliptic Hypothesis.

Argu. ☉ mean Longit. —— Longit. ☉ Apo.

S.	0		1		2		S.
	Log. dist.	Diff.	Log. dist.	Diff.	Log. dist.	Diff.	
o	Part.	Part.	Part.	Part.	Part.	Part.	o
0	0.007236	1	0.006303	62	0.003724	108	30
1	0.007235	3	0.006241	64	0.003616	109	29
2	0.007232	5	0.006177	65	0.003507	110	28
3	0.007227	7	0.006112	67	0.003397	112	27
4	0.007220	10	0.006045	69	0.003285	112	26
5	0.007210	12	0.005976	71	0.003173	113	25
6	0.007198	14	0.005905	73	0.003060	114	24
7	0.007184	16	0.005832	74	0.002946	115	23
8	0.007168	17	0.005758	76	0.002831	116	22
9	0.007151	20	0.005682	78	0.002715	118	21
10	0.007131	22	0.005604	80	0.002597	119	20
11	0.007109	24	0.005524	81	0.002478	119	19
12	0.007085	26	0.005443	83	0.002359	119	18
13	0.007059	29	0.005360	84	0.002240	120	17
14	0.007030	31	0.005276	86	0.002120	121	16
15	0.006999	33	0.005190	88	0.001999	122	15
16	0.006966	35	0.005102	89	0.001877	122	14
17	0.006931	36	0.005013	91	0.001755	123	13
18	0.006895	38	0.004922	92	0.001632	124	12
19	0.006857	40	0.004830	94	0.001508	124	11
20	0.006817	42	0.004736	95	0.001384	125	10
21	0.006775	44	0,004641	97	0.001259	125	9
22	0.006731	47	0.004544	98	0.001134	125	8
23	0.006684	49	0.004446	99	0.001009	125	7
24	0.006635	51	0.004347	100	0.000884	126	6
25	0.006584	53	0.004247	102	0.000758	126	5
26	0.006531	54	0.004145	103	0.000632	127	4
27	0.006477	56	0.004042	105	0.000505	127	3
28	0.006421	58	0.003937	106	0.000378	127	2
29	0.006363	60	0.093831	107	0.000251	128	1
30	0.006303		0.003724		0.000123		0
S.	11		10		9		S.

S.	3		4		5		S.
	Log. dist.	Diff.	Log. dist.	Diff.	Log. dist.	Diff.	
o	Part.	Part.	Part.	Part.	Part.	Part.	o
0	0.000123	127	9.996430	112	9.993664	66	30
1	9.999996	128	9.996318	111	9.993598	63	29
2	9.999868	127	9.996207	110	9.993535	61	28
3	9.999741	127	9.996097	110	9.993474	59	27
4	9.999614	127	9.995987	108	9.993415	58	26
5	9.999487	127	9.995879	107	9.993357	55	25
6	9.999360	127	9.995772	105	9.993302	53	24
7	9.999233	127	9.995667	104	9.993249	51	23
8	9.999106	127	9.995563	103	9.993198	49	22
9	9.998979	127	9.995460	102	9.993149	47	21
10	9.998852	126	9.995358	100	9.993102	45	20
11	9.998726	126	9.995158	98	9.993057	43	19
12	9.998600	126	9.995160	97	9.993014	40	18
13	9.998474	126	9.995063	96	9.992974	37	17
14	9.998348	125	9.994967	94	9.992937	35	16
15	9.998223	125	9.994873	93	9.992902	34	15
16	9.998098	124	9.994780	91	9.992868	32	14
17	9.997974	123	9.994689	90	9.992836	29	13
18	9.997851	122	9.994599	88	9.992807	26	12
19	9.997729	121	9.994511	86	9.992781	24	11
20	9.997608	121	9.994425	83	9.992757	22	10
21	9.997487	120	9.994342	82	9.992735	20	9
22	9.997367	120	9.994260	81	9.992715	18	8
23	9.997247	119	9.994179	80	9.992697	15	7
24	9.997128	119	9.994099	78	9.992682	13	6

S.	3		4		5		S.
	Log. dist.	Diff.	Log. dist.	Diff.	Log. dist.	Diff.	
o	Part.	Part.	Part.	Part.	Part.	Part.	o
25	9.997009	118	9.994021	75	9.992669	11	5
26	9.996891	117	9.993946	73	9.992658	8	4
27	9.996774	116	9.993873	71	9.992850	5	3
28	9.996658	115	9.993802	70	9.992645	3	2
29	9.996543	113	9.993732	68	9.992642	1	1
30	9.996430		9.993664		9.992641		0
S.	8		7		6		S.

For log. of the ☉ dist. from the Earth. Equa. ☽.

Arg. Num. I. ☽.

	0	100	200	300	400	
	+	+	±	—	—	
N.	P.	P.	P.	P.	P.	N.
0	17	14	5	5	14	100
10	17	13	4	6	14	90
20	17	13	3	7	15	80
30	16	12	2	8	15	70
40	16	11	1	9	16	60
50	16	10	0	10	16	50
60	16	9	1	11	16	40
70	15	8	2	12	16	30
80	15	7	3	13	17	20
90	14	6	4	13	17	10
100	14	5	5	14	17	0
	+	+	±	—	—	
	900	800	700	600	500	

For log. of the ☉ dist. from the Earth. Equa. ♃.

Arg. Num. II. ♃.

	0	100	200	300	400	
	+	+	+	—	—	
N.	P.	P.	P.	P.	P.	N.
0	4	4	4	0	6	100
10	4	5	4	0	6	90
20	4	5	4	1	7	80
30	4	5	3	2	8	70
40	4	5	3	2	8	60
50	4	5	3	3	9	50
60	4	5	2	4	9	40
70	4	4	2	4	9	30
80	4	4	1	5	9	20
90	4	4	1	6	9	10
100	4	4	0	6	9	0
	+	+	+	—	—	
	900	800	700	600	500	

For log. of the ☉ dist. from the Earth. Equa. ♀.

Arg. Num. III. ♀.

	0	100	200	300	400	
	+	—	—	∓	+	
N.	P.	P.	P.	P.	P.	N.
0	4	0	5	3	3	100
10	4	1	5	3	3	90
20	4	1	5	2	4	80
30	3	2	5	2	4	70
40	3	3	5	1	5	60
50	3	3	4	0	5	50
60	2	4	4	1	5	40
70	2	4	4	2	5	30
80	1	4	4	2	6	20
90	1	5	3	3	6	10
100	0	5	3	3	6	0
	+	—	—	∓	+	
	900	800	700	600	500	

For log. of the ☉ dist. from the Earth. Equa. ☊.

Arg. Num. IV. ☊.

	0	100	200	00	400	
	+	+	±	—	—	
N	″	″	″	″	″	N.
0	9,6	7,8	3,0	3,0	7,8	100
10	9,6	7,4	2,4	3,5	8,1	90
20	9,5	7,0	1,8	4,1	8,4	80
30	9,4	6,6	1,2	4,6	8,7	70
40	9,3	6,1	0,6	5,2	8,9	60
50	9,1	5,7	0,0	5,7	9,1	50
60	8,9	5,2	0,6	6,1	9,3	40
70	8,7	4,6	1,2	6,6	9,4	30
80	8,4	4,1	1,8	7,0	9,5	20
90	8,1	3,5	2,4	7,4	9,6	10
100	7,8	3,0	3,0	7,8	9,6	0
	+	+	±	—	—	
	900	800	700	600	500	

For the apparent semidiameter and hourly motion of the Sun.

Argument. ☉ mean Longit. —— Longit. ☉ Apogee.

S.	0		1		2		3		4		5		S.
	Sem. ☉	H. M. ☉	Sem. ☉	H. M. ☉	Sem. ☉	H. M. ☉	Sem. ☉	H. M. ☉	Sem. ☉	H. M. ☉	Sem. ☉	H. M. ☉	
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	°
0	15 46,9	2 23,0	15 48,9	2 23,6	15 54,6	2 25,3	16 2,5	2 27,7	16 10,7	2 30,2	16 16,9	2 32,2	30
1	15 46,9	2 23,0	15 49,0	2 23,6	15 54,8	2 25,3	16 2,8	2 27,8	16 11,0	2 30,3	16 17,1	2 32,2	29
2	15 46,9	2 23,0	15 49,2	2 23,7	15 55,1	2 25,4	16 3,1	2 27,9	16 11,2	2 30,4	16 17,2	2 32,3	28
3	15 46,9	2 23,0	15 49,3	2 23,7	15 55,3	2 25,4	16 3,3	2 28,0	16 11,5	2 30,4	16 17,4	2 32,3	27
4	15 46,9	2 23,0	15 49,5	2 23,8	15 55,6	2 25,5	16 3,6	2 28,1	16 11,7	2 30,5	16 17,5	2 32,3	26
5	15 46,9	2 23,0	15 49,6	2 23,8	15 55,8	2 25,6	16 3,9	2 28,2	16 12,0	2 30,6	16 17,6	2 32,4	25
6	15 47,0	2 23,0	15 49,8	2 23,9	15 56,1	2 25,6	16 4,2	2 28,3	16 12,2	2 30,7	16 17,8	2 32,4	24
7	15 47,0	2 33,0	15 49,9	2 23,6	15 56,3	2 25,7	16 4,5	2 28,4	16 12,5	2 30,8	12 17,9	2 32,5	23
8	15 47,0	2 23,0	15 50,1	2 24,0	15 56,6	2 25,8	16 4,7	2 28,5	16 12,7	2 30,8	16 18,0	2 32,5	22
9	15 47,1	2 23,0	15 50,3	2 24,0	15 56,8	2 25,9	16 5,0	2 28,5	16 12,9	2 30,9	16 18,1	2 32,5	21
10	15 47,1	2 23,0	15 50,5	2 24,1	15 57,1	2 26,0	16 5,3	2 28,6	16 13,1	2 31,0	16 18,2	2 32,6	20
11	15 47,1	2 23,0	15 50,7	2 24,1	15 57,4	2 26,1	16 5,6	2 28,7	16 13,3	2 31,1	16 18,3	2 32,6	19
12	15 47,2	2 23,1	15 50,8	2 24,2	15 57,6	2 26,1	16 5,9	2 28,8	16 13,6	2 31,1	16 18,4	2 32,7	18
13	15 47,2	2 23,1	15 51,0	2 24,3	15 57,9	2 26,2	16 6,1	2 28,9	16 13,8	2 31,2	16 18,5	2 32,7	17
14	15 47,3	2 23,1	15 51,2	2 24,3	15 58,1	2 26,3	16 6,4	2 28,9	16 14,0	2 31,3	16 18,6	2 32,7	16
15	15 47,4	2 23,1	15 51,4	2 24,4	15 58,4	2 26,4	16 6,7	2 29,0	16 14,2	2 31,4	16 18,7	2 32,8	15
16	15 47,4	2 23,1	15 51,6	2 24,5	15 58,7	2 26,5	16 7,0	2 29,1	16 14,4	2 31,5	16 18,8	2 32,8	14
17	15 47,5	2 23,2	15 51,8	2 24,5	15 58,9	2 26,5	16 7,3	2 29,2	16 14,6	2 31,5	16 18,9	2 32,8	13
18	15 47,6	2 23,2	15 52,0	2 24,6	15 59,2	2 26,6	16 7,5	2 29,2	16 14,8	2 31,6	16 18,9	2 32,8	12
19	15 47,7	2 23,2	15 52,2	2 24,6	15 59,4	2 26,7	16 7,8	2 29,3	16 15,0	2 31,7	16 19,0	2 32,8	11
20	15 47,8	2 23,2	15 52,4	2 24,7	15 59,7	2 26,8	16 8,1	2 29,4	16 15,2	2 31,7	16 19,0	2 32,8	10
21	15 47,6	2 23,3	15 52,6	2 24,7	16 0,0	2 26,9	16 8,4	2 29,5	16 15,4	2 31,8	16 19,1	2 32,8	9
22	15 48,0	2 23,3	15 52,8	2 24,8	16 0,3	2 27,0	16 8,6	2 29,6	16 15,6	2 31,8	16 19,1	2 32,8	8
23	15 48,1	2 23,3	15 53,0	2 24,8	16 0,5	2 27,1	16 8,9	2 29,7	16 15,8	2 31,9	16 19,1	2 32,9	7
24	15 48,2	2 23,4	15 53,2	2 24,9	16 0,8	2 27,2	16 9,2	2 29,7	16 16,0	2 32,0	16 19,2	2 32,9	6
25	15 48,3	2 23,4	15 53,4	2 25,0	16 1,1	2 27,3	16 9,5	2 29,8	16 16,1	2 32,0	16 19,2	2 32,9	5
26	15 48,4	2 23,4	15 53,6	2 25,1	16 1,4	2 27,3	16 9,8	2 29,9	16 16,3	2 32,1	16 19,2	2 32,9	4
27	15 48,5	2 23,5	15 53,8	2 25,1	16 1,7	2 27,4	16 10,0	2 30,0	16 16,4	2 32,1	16 19,2	2 32,9	3
28	15 48,6	2 23,5	15 54,1	2 25,2	16 1,9	2 27,5	16 10,3	2 30,1	16 16,6	2 32,2	16 19,2	2 32,9	2
29	15 48,8	2 23,6	15 54,3	2 25,2	16 2,2	2 27,6	16 10,5	2 30,1	16 16,8	2 32,2	16 19,3	2 32,9	1
30	15 48,9	2 23,6	15 54,6	2 25,3	16 2,5	2 27,7	16 10,7	2 30,2	16 16,9	2 32,2	16 19,3	2 32,9	0
S.	11		10		9		8		7		6		S.

For right Ascension of a Point of the Ecliptic. Reduction of the Ecliptic to the Equator.

According to the obliquity of the Ecliptic 23° 28′ 15″,
With the change of reduction for the change of the obliquity one minute.

Argument. Longitude of a point in the Ecliptic.

S.	0 — 6	Diff.	Change.	1 — 7	Diff.	Change.	2 — 8	Diff.	Change.	S.
° ′	° ′ ″	′ ″	″	° ′ ″	′ ″	″	° ′ ″	′ ″	″	° ′
0 0	0 0 0,0	2 28,9	0,0	2 5 42,4	1 19,7	10,8	2 11 14,7	1 15,3	11,7	30 0
0 30	0 2 28,9	2 28,9	0,2	2 7 2,1	1 17,5	10,9	2 9 59,4	1 17,7	11,6	29 30
1 0	0 4 57,8	2 28,8	0,4	2 8 19,6	1 15,3	11,0	2 8 41,6	1 20,4	11,5	29 0
1 30	0 7 26,6	2 28,7	0,6	2 9 34,9	1 13,0	11,1	2 7 21,2	1 22,8	11,4	28 30
2 0	0 9 55,3	2 28,5	0,8	2 10 47,9	1 10,8	11,2	2 5 58,4	1 25,2	11,3	28 0
2 30	0 12 23,8	2 28,3	1,0	2 11 58,7	1 8,6	11,3	2 4 33,2	1 27,8	11,2	27 30
3 0	0 14 52,1	2 28,1	1,3	2 13 7,3	1 6,3	11,5	2 3 5,4	1 30,1	11,1	27 0
3 30	0 17 20,2	2 27,8	1,5	2 14 13,6	1 4,0	11,6	2 1 35,3	1 32,6	10,9	26 30
4 0	0 19 48,0	2 27,5	1,7	2 15 17,6	1 1,5	11,7	2 0 2,7	1 35,0	10,8	26 0
4 30	0 22 15,5	2 27,1	1,9	2 16 19,1	0 59,1	11,8	1 58 27,7	1 37,2	10,7	25 30
5 0	0 24 42,6	2 26,7	2,1	2 17 18,2	0 56,9	11,8	1 56 50,5	1 39,6	10,5	25 0
5 30	0 27 9,3	2 26,3	2,3	2 18 15,1	0 54,4	11,9	1 55 10,9	1 41,9	10,4	24 30
6 0	0 29 35,6	2 25,9	2,5	2 19 9,5	0 51,9	12,0	1 53 29,0	1 44,2	10,2	24 0
6 30	0 32 1,5	2 25,3	2,7	2 20 1,4	0 49,6	12,1	1 51 44,8	1 46,3	10,1	23 30
7 0	0 34 26,8	2 24,7	2,9	2 20 51,0	0 47,1	12,2	1 49 58,5	1 48,5	9,9	23 0
7 30	0 36 51,5		3,1	2 21 38,1		12,2	1 48 10,0		9,8	22 30

For right Ascension of a Point of the Ecliptic. Reduction of the Ecliptic to the Equator.

According to the obliquity of the Ecliptic, 23° 28′ 15″,

With the change of reduction for the change of the Obliquity one minute.

Argument. Longitude of a point in the Ecliptic.

S.		0	6					1	7					2	8					S.	
		——			Diff.		Change.	——			Diff.		Change.	——			Diff.		Change.		
°	′	°	′	″	′	″	″	°	′	″	′	″	″	°	′	″	′	″	″	°	′
8	0	0	39	15,6	2	25,8	3,3	2	22	22,6	0	44,5	12,3	1	46	19,3	1	50,7	9,6	22	0
8	30	0	41	39,1	2	23,5	3,5	2	23	4,6	0	42,0	12,4	1	44	26,5	1	52,8	9,4	21	30
9	0	0	44	2,0	2	22,9	3,7	2	23	44,1	0	39,5	12,5	1	42	31,5	1	55,0	9,3	21	0
9	30	0	46	24,2	2	22,2	3,9	2	24	21,0	0	36,9	12,5	1	40	34,5	1	57,0	9,1	20	30
10	0	0	48	45,5	2	21,3	4,1	2	24	55,5	0	34,5	12,6	1	38	35,5	1	59,0	8,9	20	0
10	30	0	51	6,1	2	20,6	4,3	2	25	27,3	0	31,8	12,6	1	36	34,5	2	1,0	8,8	19	30
11	0	0	53	25,9	2	19,8	4,5	2	25	56,6	0	29,3	12,7	1	34	31,5	2	3,0	8,6	19	0
11	30	0	55	44,8	2	18,9	4,7	2	26	23,2	0	26,6	12,7	1	32	26,7	2	4,8	8,4	18	30
12	0	0	58	2,8	2	18,0	4,9	2	26	47,2	0	24,0	12,8	1	30	19,9	2	6,8	8,2	18	0
12	30	1	0	19,9	2	17,1	5,1	2	27	8,7	0	21,5	12,8	1	28	11,2	2	8,7	8,0	17	30
13	0	1	2	35,9	2	16,0	5,3	2	27	27,3	0	18,6	12,9	1	26	1,0	2	10,2	7,8	17	0
13	30	1	4	50,9	2	15,0	5,5	2	27	43,3	0	16,0	12,9	1	23	48,9	2	12,1	7,6	16	30
14	0	1	7	4,9	2	14,0	5,7	2	27	56,8	0	13,5	12,9	1	21	35,1	2	13,1	7,4	16	0
14	30	1	9	17,8	2	12,9	5,8	2	28	7,6	0	10,8	13,0	1	19	19,7	2	15,4	7,2	15	30
15	0	1	11	29,6	2	11,8	6,0	2	28	15,6	0	8,0	13,0	1	17	2,6	2	17,1	7,0	15	0
15	30	1	13	40,2	2	10,6	6,2	2	28	20,9	0	5,3	13,0	1	14	44,0	2	18,6	6,8	14	30
16	0	1	15	49,6	2	9,4	6,4	2	28	23,9	0	2,7	13,0	1	12	23,7	2	20,3	6,6	14	0
16	30	1	17	57,8	2	8,2	6,6	2	28	23,6	0	0,0	13,0	1	10	1,9	2	21,8	6,4	13	30
17	0	1	20	4,6	2	6,8	6,8	2	28	20,7	0	2,9	13,0	1	7	38,9	2	23,0	6,2	13	0
17	30	1	22	10,1	2	5,5	7,0	2	28	15,0	0	5,7	13.0	1	5	14,5	2	24.5	6,0	12	30
18	0	1	24	14,4	2	4,3	7,1	2	28	6,9	0	8,1	13,0	1	2	48,6	2	25,9	5,7	12	0
18	30	1	26	17,3	2	2,9	7,3	2	27	56,1	0	10,8	13,0	1	0	21.4	2	27,2	5,5	11	30
19	0	1	28	18,7	2	1,4	7,5	2	27	42,3	0	13,8	13,0	0	57	53,1	2	28,3	5,3	11	0
19	30	1	30	18,7	2	0,0	7,6	2	27	25,8	0	16,5	13,0	0	55	23,5	2	29,6	5,1	10	30
20	0	1	32	17,1	1	58,4	7,8	2	27	6,6	0	19,2	13,0	0	52	52,8	2	30,7	4,8	10	0
20	30	1	34	14,1	1	57,0	8,0	2	26	44,7	0	21,9	12,9	0	50	21,0	2	31,8	4,6	9	30
21	0	1	36	9,4	1	55,3	8,2	2	26	20,1	0	24,6	12,9	0	47	48,1	2	32,9	4,4	9	0
21	30	1	38	3,2	1	53,8	8,3	2	25	52,6	0	27,5	12.9	0	45	14,3	2	33,8	4,2	8	30
22	0	1	39	55,4	1	52,2	8,5	2	25	22,6	0	30,0	12,9	0	42	39,5	2	34,8	3,9	8	0
22	30	1	41	45,8	1	50,4	8,7	2	24	49,9	0	32,7	12,8	0	40	3,8	2	35,7	3,6	7	30
23	0	1	43	34,7	1	48,9	8,8	2	24	14,2	0	35,7	12,8	0	37	27,4	2	36,4	3,4	7	0
23	30	1	45	21,8	1	47,1	9,0	2	23	35,8	0	38,4	12,7	0	34	50,2	2	37,2	3,1	6	30
24	0	1	47	7,1	1	45,3	9,1	2	22	54,9	0	40,9	12,7	0	32	12,1	2	38,1	2,9	6	0
24	30	1	48	50,6	1	43,5	9,3	2	22	11,3	0	43,6	12,6	0	29	33,4	2	38,7	2,7	5	30
25	0	1	50	32,3	1	41,7	9,4	2	21	24,8	0	46,5	12,6	0	26	54,2	2	39,2	2,5	5	0
25	30	1	52	12,2	1	39,9	9,6	2	20	35,6	0	49,2	12,5	0	24	14,5	2	39,7	2,2	4	30
26	0	1	53	50,1	1	37,9	9,7	2	19	43,9	0	51,7	12,4	0	21	34,1	2	40,4	2,0	4	0
26	30	1	55	26,1	1	36,0	9,9	2	18	49,6	0	54,3	12,4	0	18	53,3	2	40,8	1,8	3	30
27	0	1	57	0,3	1	34,2	10,0	2	17	52,4	0	57,2	12,3	0	16	12,1	2	41,2	1,5	3	0
27	30	1	58	32,4	1	32,1	10,1	2	16	52,6	0	59,8	12,2	0	13	30,6	2	41,5	1,3	2	30
28	0	2	0	2,5	1	30,1	10,3	2	15	50,2	1	2,4	12,1	0	10	48,8	2	41,8	1,0	2	0
28	30	2	1	30,6	1	28,1	10,4	2	14	45,2	1	5,0	12,0	0	8	6,8	2	42,0	0,7	1	30
29	0	2	2	56,6	1	26,0	10,5	2	13	37,7	1	7,5	11,9	0	5	24,6	2	42,2	0,5	1	0
29	30	2	4	20,6	1	24,0	10,7	2	12	27,5	1	10,2	11,8	0	2	42,3	2	42,3	0,3	0	30
30	0	2	5	42,4	1	21,8	10,8	2	11	14,7	1	12,8	11,7	0	0	0,0	2	42,3	0,0	0	0
		+						+						+							
S.		5	11					4	10					3	9					S.	

Declination of the Points of the Ecliptic.

According to the Obliquity of the Ecliptic, 23°. 28′. 15″.

With the Change of Reduction, for the Change of the Obliquity, one Minute.

Argument. Longitude of the Point in the Ecliptic.

S.		0 + 6 —						1 + 7 —						2 + 8 —						S.	
		Declination.			Diff.		Change.	Declination.			Diff.		Change.	Declination.			Diff.		Change.		
°	′	°	′	″	′	″	″	°	′	″	′	″	″	°	′	″	′	″	″	°	′
0	0	0	0	0,0	11	57,0	0,0	11	29	12,3	10	32,1	28,1	20	10	37,4	6	19,2	50,8	30	0
0	30	0	11	57,0	11	56,8	0,5	11	39	44,4	10	29,2	28,5	20	16	56,6	6	13,5	51,1	29	30
1	0	0	23	53,8	11	56,7	1,0	11	50	13,7	10	26,4	29,0	20	23	10,1	6	8,0	51,4	29	0
1	30	0	35	50,5	11	56,6	1,4	12	0	40,1	10	23,5	29,4	20	29	18,1	6	2,4	51,7	28	30
2	0	0	47	47,1	11	56,4	1,9	12	11	3,6	10	20,5	29,9	20	35	20,5	5	56,7	51,9	28	0
2	30	0	59	43,5	11	56,3	2,4	12	21	24,1	10	17,4	30,3	20	41	17,2	5	51,0	52,2	27	30
3	0	1	11	39,8	11	55,9	2,9	12	31	41,5	10	14,3	30,7	20	47	8,2	5	45,2	52,4	27	0
3	30	1	23	35,7	11	55,6	3,4	12	41	55,8	10	11,3	31,2	20	52	53,4	5	39,5	52,7	26	30
4	0	1	35	31,3	11	55,3	3,8	12	52	7,1	10	8,1	31,6	20	58	32,9	5	33,7	53,0	26	0
4	30	1	47	26,6	11	54,8	4,3	13	2	15,2	10	4,8	32,0	21	4	6,6	5	27,8	53,2	25	30
5	0	1	59	21,4	11	54,5	4,8	13	12	20,0	10	1,5	32,4	21	9	34,4	5	21,9	53,5	25	0
5	30	2	11	15,9	11	53,8	5,3	13	22	21,5	9	58,3	32,8	21	14	56,3	5	16,0	53,7	24	30
6	0	2	23	9,7	11	53,3	5,8	13	32	19,8	9	54,9	33,3	21	20	12,3	5	10,1	54,0	24	0
6	30	2	35	3,0	11	52,7	6,2	13	42	14,7	9	51,5	33,7	21	25	22,4	5	4,1	54,2	23	30
7	0	2	46	55,7	11	52,2	6,7	13	52	6,2	9	48,0	34,1	21	30	26,5	4	58,2	54,5	23	0
7	30	2	58	47,9	11	51,3	7,2	14	1	54,2	9	44,4	34,5	21	35	24,7	4	51,9	54,7	22	30
8	0	3	10	39,2	11	50,7	7,7	14	11	38,6	9	40,8	35,0	21	40	16,6	4	45,9	54,9	22	0
8	30	3	22	29,9	11	49,8	8,2	14	21	19,4	9	37,5	35,4	21	45	2,5	4	39,8	55,2	21	30
9	0	3	34	19,7	11	48,9	8,6	14	30	56,9	9	33,7	35,8	21	49	42,3	4	33,6	55,4	21	0
9	30	3	46	8,6	11	48,3	9,1	14	40	30,6	9	30,0	36,2	21	54	15,9	4	27,6	55,6	20	30
10	0	3	57	56,9	11	47,3	9,6	14	50	0,6	9	26,1	36,6	21	58	43,5	4	21,3	55,8	20	0
10	30	4	9	44,2	11	46,2	10,1	14	59	26,7	9	22,5	37,0	22	3	4,8	4	15,1	56,0	19	30
11	0	4	21	30,4	11	45,3	10,6	15	8	49,2	9	18,6	37,4	22	7	19,9	4	9,0	56,2	19	0
11	30	4	33	15,7	11	44,2	11,0	15	18	7,8	9	14,8	37,8	22	11	28,9	4	2,4	56,4	18	30
12	0	4	44	59,9	11	43,1	11,5	15	27	22,6	9	10,7	38,2	22	15	31,3	3	56,1	56,6	18	0
12	30	4	56	43,0	11	41,9	12,0	15	36	33,3	9	6,8	38,6	22	19	27,4	3	49,9	56,8	17	30
13	0	5	8	24,9	11	40,8	12,4	15	45	40,1	9	2,8	39,0	22	23	17,3	3	43,5	57,0	17	0
13	30	5	20	5,7	11	39,5	12,9	15	54	42,9	8	58,7	39,4	22	27	0,8	3	37,2	57,1	16	30
14	0	5	31	45,2	11	38,2	13,4	16	3	41,6	8	54,6	39,8	22	30	38,0	3	30,6	57,3	16	0
14	30	5	43	23,4	11	36,8	13,9	16	12	36,2	8	50,4	40,2	22	34	8,6	3	24,3	57,5	15	30
15	0	5	55	0,2	11	35,6	14,3	16	21	26,6	8	46,2	40,6	22	37	32,9	3	17,7	57,6	15	0
15	30	6	6	35,8	11	34,0	14,8	16	30	12,8	8	42,0	41,0	22	40	50,6	3	11,4	57,8	14	30
16	0	6	18	9,8	11	32,6	15,3	16	38	54,8	8	37,6	41,4	22	44	2,0	3	4,8	57,9	14	0
16	30	6	29	42,4	11	31,0	15,7	16	47	32,4	8	33,3	41,7	22	47	6,8	2	58,2	58,0	13	30
17	0	6	41	13,4	11	29,5	16,2	16	56	5,7	8	28,8	42,1	22	50	5,0	2	51,8	58,2	13	0
17	30	6	52	42,9	11	27,9	16,7	17	4	34,5	8	24,5	42,5	22	52	56,8	2	45,1	58,3	12	30
18	0	7	4	10,8	11	26,1	17,1	17	12	59,0	8	20,4	42,9	22	55	41,9	2	38,5	58,4	12	0
18	30	7	15	36,9	11	24,6	17,6	17	21	19,4	8	15,0	43,2	22	58	20,4	2	31,9	58,6	11	30
19	0	7	27	1,5	11	22,6	18,1	17	29	34,4	8	10,8	43,6	23	0	52,3	2	25,3	58,7	11	0
19	30	7	38	24,1	11	21,0	18,5	17	37	45,2	8	6,3	43,9	23	3	17,6	2	18,7	58,8	10	30
20	0	7	49	45,1	11	19,2	19,0	17	45	51,5	8	1,5	44,3	23	5	36,3	2	12,0	58,9	10	0
20	30	8	1	4,3	11	17,1	19,4	17	53	53,0	7	56,8	44,6	23	7	48,3	2	5,3	59,0	9	30
21	0	8	12	21,4	11	15,3	19,9	18	1	49,8	7	52,1	45,0	23	9	53,6	1	58,6	59,1	9	0
21	30	8	23	36,7	11	13,2	20,4	18	9	41,9	7	47,3	45,3	23	11	52,2	1	52,0	59,2	8	30
22	0	8	34	49,9	11	11,1	20,8	18	17	29,2	7	42,4	45,7	23	13	44,2	1	45,2	59,3	8	0
22	30	8	46	1,0	11	9,2	21,3	18	25	11,6	7	37,6	46,0	23	15	29,4	1	38,5	59,4	7	30
23	0	8	57	10,2	11	7,1	21,7	18	32	49,2	7	32,6	46,4	23	17	7,9	1	31,7	59,5	7	0
23	30	9	8	17,3	11	4,7	22,2	18	40	21,8	7	27,6	46,7	23	18	39,6	1	25,0	59,5	6	30
24	0	9	19	22,0	11	2,6	22,7	18	47	49,4	7	22,7	47,1	23	20	4,6	1	18,2	59,6	6	0
24	30	9	30	24,6	11	0,2	23,2	18	55	12,1	7	17,5	47,4	23	21	22,8	1	11,5	59,6	5	30
25	0	9	41	24,8	10	58,0	23,6	19	2	29,6	7	12,4	47,7	23	22	34,3	1	4,7	59,7	5	0
25	30	9	52	22,8	10	55,6	24,1	19	9	42,0	7	7,3	48,0	23	23	39,0	0	57,9	59,7	4	30
26	0	10	3	18,4	10	53,2	24,5	19	16	49,3	7	2,1	48,4	23	24	36,9	0	51,1	59,8	4	0
26	30	10	14	11,6	10	50,7	25,0	19	23	51,4	6	56,9	48,7	23	25	28,0	0	44,3	59,8	3	30
27	0	10	25	2,3	10	48,3	25,5	19	30	48,3	6	51,6	49,0	23	26	12,3	0	37,5	59,8	3	0
27	30	10	35	50,6	10	45,6	25,9	19	37	39,9	6	46,3	49,3	23	26	49,8	0	30,6	59,9	2	30
28	0	10	46	36,2	10	42,9	26,3	19	44	26,2	6	41,1	49,6	23	27	20,4	0	23,9	59,9	2	0
28	30	10	57	19,1	10	40,5	26,8	19	51	7,3	6	35,5	49,9	23	27	44,3	0	17,1	59,9	1	30
29	0	11	7	59,6	10	37,8	27,2	19	57	42,8	6	30,0	50,2	23	28	1,4	0	10,2	60,0	1	0
29	30	11	18	37,4	10	34,9	27,7	20	4	12,8	6	24,6	50,5	23	28	11,6	0	3,4	60,0	0	30
30	0	11	29	12,3			28,1	20	10	37,4			50,8	23	28	15,0			60,0	0	0
S.		5 + 11 —						4 + 10 —						3 + 9 —						S.	

Sun's parallax, In the vertical circle.		ASTRONOMICAL REFRACTIONS. For the height of the barometer 28°. 0′ Paris, and the graduation of Reaumur's thermometer, 10°. above freezing, with variations for 10 lines in the height of the barometer, and 10 degrees of the thermometer.*											
Dist. from vert.	Sun's Parallax	Dist. from vert.	Refract for bar. 28d th. + 10	Var. for 10 lin. bar.	Var. for 10 d. ther.	Dist. from vert.	Refract for bar 28d 0′ th. + 10	Var. for 10 lin. bar.	Var. for 10 d. ther.	Dist. from vert.	Refract. for bar. 28d 0′ ther. + 10.	Var. for 10 lin. bar.	Var. for 10 d. ther.
°	″	°	′ ″	″	″	°	′ ″	″	″	°	″	″	″
0	0,0	0	0 0,0	0,0	0,0	30	0 33,1	1,0	1,5	60	1 39,0	2,9	4,5
3	0,4	1	0 1,0	0,0	0,0	31	0 34,4	1,0	1,5	61	1 43,2	3,0	4,7
6	0,9	2	0 2,0	0,1	0,1	32	0 35,8	1,1	1,6	62	1 47,6	3,1	4,9
9	1,4	3	0 3,0	0,1	0,1	33	0 37,2	1,1	1,7	63	1 52,3	3,2	5,1
12	1,8	4	0 4,0	0,1	0,2	34	0 38,7	1,2	1,7	64	1 57,2	3,4	5,3
15	2,3	5	0 5,0	0,2	0,2	35	0 40,2	1,2	1,8	65	2 2,4	3,5	5,6
18	2,7	6	0 6,1	0,2	0,2	36	0 41,7	1,2	1,9	66	2 8,0	3,7	5,9
21	3,1	7	0 7,1	0,2	0,3	37	0 43,3	1,3	2,0	67	2 14,2	4,0	6,3
24	3,6	8	0 8,1	0,2	0,3	38	0 44,9	1,3	2,0	68	2 20,9	4,2	6,6
27	4,0	9	0 9,2	0,3	0,4	39	0 46,5	1,4	2,1	69	2 28,3	4,4	6,9
30	4,4	10	0 10,2	0,3	0,4	40	0 48,1	1,4	2,2	70	2 36,3	4,7	7,3
33	4,8	11	0 11,2	0,3	0,5	41	0 49,8	1,5	2,2	71	2 45,1	5,0	7,7
36	5,2	12	0 12,3	0,4	0,5	42	0 51,6	1,5	2,3	72	2 54,7	5,3	8,2
39	5,5	13	0 13,3	0,4	0,6	43	0 53,4	1,6	2,4	73	3 5,5	5,6	8,7
42	5,9	14	0 14,4	0,4	0,6	44	0 55,3	1,6	2,5	74	3 17,5	5,9	9,3
45	6,2	15	0 15,4	0,5	0,7	45	0 57,3	1,7	2,6	75	3 31,0	6,3	9,9
48	6,5	16	0 16,5	0,5	0,7	46	0 59,3	1,8	2,7	76	3 46,4	6,8	10,6
51	6,8	17	0 17,6	0,5	0,8	47	1 1,4	1,9	2,8	77	4 3,8	7,3	11,5
54	7,1	18	0 18,7	0,6	0,8	48	1 3,6	2,0	2,9	78	4 24,0	7,9	12,5
57	7,4	19	0 19,8	0,6	0,9	49	1 5,9	2,0	3,0	79	4 46,6	8,6	13,7
60	7,6	20	0 20,9	0,6	0,9	50	1 8,2	2,1	3,1	80	5 15,6	9,4	14,9
63	7,8	21	0 22,0	0,7	1,0	51	1 10,6	2,2	3,2	81	5 49,0	10,4	16,5
66	8,0	22	0 23,2	0,7	1,0	52	1 13,2	2,3	3,4	82	6 29,7	11,6	18,5
69	8,2	23	0 24,3	0,7	1,1	53	1 15,9	2,3	3,5	83	7 20,3	13,1	21,3
72	8,4	24	0 25,5	0,8	1,2	54	1 18,7	2,4	3,7	84	8 24,7	15,0	24,9
75	8,5	25	0 26,7	0,8	1,2	55	1 21,6	2,5	3,8	85	9 48,8	17,5	29,6
78	8,6	26	0 28,0	0,8	1,3	56	1 24,7	2,5	3,9	86	11 41,8		
81	8,7	27	0 29,2	0,9	1,3	57	1 28,0	2,6	4,1	87	14 18,4		
84	8,7	28	0 30,5	0,9	1,4	58	1 31,5	2,7	4,2	88	18 1,3		
87	8,8	29	0 31,8	1,0	1,4	59	1 35,2	2,8	4,3	89	23 21,4		
90	8,8	30	0 33,1	1,0	1,5	60	1 39,0	2,9	4,5	90	30 50,8	55,0	129,2

* This table alſo anſwers to the height of the barometer 29,6 inches, Engliſh meaſure, and to 50° of Fahrenheit's thermometer; or to the height of the barometer 30 Engliſh inches, and 55° of Fahrenheit's thermometer. And the column of variation of refraction for 10 lines of the barometer, Paris meaſure, anſwers to a difference of 9-10ths of an inch, Engliſh meaſure, from the given height 29,6 or 30,00 inches; and the column of variation of refraction of 10° of Reaumur's thermometer anſwers to a difference of 20° of Fahrenheit's thermometer from the given degree 50 or 55°.

Epochs of the mean Motion of the Moon.

Years current. Mean Time, for the Meridian of the Royal Obſervatory at Greenwich.

Greg. Style.		Mean Long. m				Accel. +	Mean Ano. ☽				Long. ☊			
Yrs. ſince C.		s	°	′	″	″	s	°	′	″	s	°	′	″
B.	1600	3	16	17	51,0	9,0	9	8	59	46	10	1	32	6
B.	20	7	29	52	34,0	5,8	10	18	44	14	9	4	41	51
B.	40	0	13	27	17,0	3,2	11	28	28	42	8	7	51	36
B.	60	4	27	2	0,0	1,4	1	8	13	10	7	11	1	21
B.	80	9	10	36	43,0	0,4	2	17	57	38	6	14	11	6
B.	1700	1	11	0	51,0	0,0	3	14	38	12	5	17	24	1
	1	5	20	23	56,4	0,0	6	13	21	26	4	28	4	18
	2	9	29	47	1,8	0,0	9	12	4	41	4	8	44	35
	3	2	9	10	7,2	0,0	0	10	47	56	3	19	24	52
B.	4	7	1	43	47,6	0,0	3	22	35	5	3	0	1	58
	5	11	11	6	53,0	0,0	6	21	18	20	2	10	42	15
	6	3	20	29	58,4	0,0	9	20	1	35	1	21	22	32
	7	7	29	53	3,8	0,0	0	18	44	50	1	2	2	49
B.	8	0	22	26	44,2	0,1	4	0	31	59	0	12	39	55
	9	5	1	49	49,6	0,1	6	29	15	14	11	23	20	12
	1710	9	11	12	55,0	0,1	9	27	58	29	11	4	0	29
	11	1	20	36	0,[illegible]	0,1	0	25	41	43	10	14	40	46
B.	12	6	13	9	40,8	0,1	4	8	28	52	9	25	17	52
	13	10	22	32	46,2	0,2	7	7	12	7	9	5	53	9
	14	3	1	55	51,6	0,2	10	5	55	22	8	16	38	26
	15	7	11	18	57,0	0,2	1	4	38	37	7	27	18	43
B.	16	0	3	52	37,4	0,2	4	16	25	46	7	7	55	49
	17	4	13	15	42,8	0,3	7	15	9	1	6	18	36	6
	18	8	22	38	48,2	0,3	10	13	52	16	5	29	16	23
	19	1	2	1	53,6	0,3	1	12	35	31	5	9	56	40
B.	1720	5	24	35	34,0	0,4	4	24	22	40	4	20	33	46
	21	10	3	58	39,4	0,4	7	23	5	54	4	1	14	3
	22	2	13	21	44,8	0,4	10	21	49	9	3	11	54	20
	23	6	22	44	50,2	0,5	1	20	32	24	2	22	34	37
B.	24	11	15	18	30,6	0,5	5	2	19	32	2	3	11	4[illegible]
	25	3	24	41	36,0	0,6	8	1	2	48	1	13	52	0
	26	8	4	4	41,4	0,6	10	29	46	3	0	24	32	17
	27	0	13	27	46,8	0,7	1	28	29	18	0	5	12	34
B.	28	5	6	1	27,2	0,7	5	10	16	27	11	15	49	40
	29	9	15	24	32,6	0,8	8	8	59	42	10	26	29	57
	1730	1	24	47	38,[illegible]	0,8	11	7	42	57	10	7	10	14
	31	6	4	10	43,4	0,9	2	6	26	11	9	17	50	31
B.	32	10	26	44	23,8	0,9	5	18	13	20	8	28	27	37
	33	3	6	7	29,2	1,0	8	16	56	35	8	9	7	54
	34	7	15	30	34,6	1,0	11	15	39	50	7	19	48	11
	1735	11	24	53	40,0	1,1	2	14	23	5	7	0	28	28
B.	36	4	17	27	20,4	1,2	5	26	10	14	6	11	5	34
	37	8	26	50	25,8	1,2	8	24	53	29	5	21	45	51
	38	1	6	13	31,2	1,3	11	23	36	44	5	2	26	8
	39	5	15	36	36,6	1,4	2	22	19	59	4	13	6	25
B.	1740	10	8	10	17,0	1,4	6	4	7	8	3	23	43	31
	41	2	17	33	22,4	1,5	9	2	50	22	3	4	23	48
	42	6	26	56	27,8	1,6	0	1	33	37	2	15	4	5
	43	11	6	19	33,2	1,7	3	0	16	52	1	25	44	22
B.	44	2	28	53	13,6	1,7	6	12	4	1	1	6	21	28
	1745	8	8	16	19,[illegible]	1,8	9	10	47	16	0	17	1	45
	46	0	17	39	24,[illegible]	1,9	0	9	30	31	11	27	42	2
	47	4	27	2	29,8	2,0	3	8	13	46	11	8	22	19
B.	48	9	19	36	10,2	2,1	6	20	0	55	10	18	59	25
	49	1	28	59	15,6	2,2	9	18	44	10	9	29	39	42
	1750	6	8	22	21,0	2,2	0	17	27	25	9	10	19	59
	51	10	17	45	26,4	2,3	3	16	10	39	8	21	0	16
B.	52	3	10	19	6,[illegible]	2,4	6	27	57	48	8	1	37	22
	53	7	19	42	12,2	2,5	9	26	41	3	7	12	17	39
	54	11	29	5	17,6	2,6	0	25	24	18	6	22	57	56
	1755	4	8	28	[illegible]	2,7	3	24	7	32	6	3	38	13
B.	56	9	1	2	3,4	2,8	7	5	54	42	5	14	15	19
	57	1	10	25	8,8	2,9	10	4	37	57	4	24	55	36
	58	5	19	48	14,2	3,0	1	3	21	12	4	5	35	53
	59	0	20	11	10,[illegible]	3,1	4	2	4	27	[illegible]	16	16	1[illegible]

Greg. Style.		Mean Long. ☽				Accel. +	Mean Ano. ☽				Long. ☊			
Yrs. ſince C.		s	°	′	″	″	s	°	′	″	s	°	′	″
B.	1760	2	21	45	0,0	3,2	7	13	51	36	2	26	53	16
	61	7	1	8	5,4	3,4	10	12	34	50	2	7	33	33
	62	11	10	31	10,8	3,5	1	11	18	5	1	18	13	50
	63	3	19	54	16,2	3,6	4	10	1	20	0	28	54	7
B.	64	8	12	27	56,6	3,7	7	21	48	29	0	9	31	13
	1765	0	21	51	2,0	3,8	10	20	31	44	11	20	11	30
	66	5	1	14	7,4	3,9	1	19	14	59	11	0	51	47
	67	9	10	37	12,8	4,0	4	17	58	14	10	11	32	4
B.	68	2	3	10	53,2	4,2	7	29	45	23	9	22	9	10
	69	6	12	33	58,6	4,3	0	28	28	38	9	2	49	27
	1770	10	21	57	4,0	4,4	1	27	11	53	8	13	29	44
	71	3	1	20	9,4	4,5	4	25	55	7	7	24	10	1
B.	72	7	23	53	49,8	4,7	8	7	42	16	7	4	47	7
	73	0	3	16	55,2	4,8	11	6	25	31	6	15	27	24
	74	4	12	40	0,6	4,9	2	5	8	46	5	26	7	41
	1775	8	22	3	6,0	5,1	5	3	52	1	5	6	47	58
B.	76	1	14	36	46,4	5,2	8	15	39	10	4	17	25	4
	77	5	23	59	51,8	5,3	11	14	22	25	3	28	5	21
	78	10	3	22	57,2	5,5	2	13	5	40	3	8	45	38
	79	2	12	46	2,6	5,6	5	11	48	55	2	19	25	55
B.	1780	7	5	19	43,0	5,8	8	23	36	4	2	0	3	1
	81	11	14	42	48,4	5,9	11	22	19	18	1	10	43	18
	82	3	24	5	53,8	6,1	2	21	2	33	0	21	23	35
	83	8	3	28	59,2	6,2	5	19	45	48	0	2	3	52
B.	84	0	26	2	39,6	6,4	9	1	32	57	11	12	40	58
	1785	5	5	25	45,0	6,5	0	0	16	12	10	23	21	15
	86	9	14	48	50,4	6,7	2	28	59	27	10	4	1	32
	87	1	24	11	55,8	6,8	5	27	42	42	9	14	41	49
B.	88	6	16	45	36,2	7,0	9	9	29	51	8	25	18	55
	89	10	26	8	41,6	7,1	0	8	13	6	8	5	59	12
	1790	3	5	31	47,0	7,3	3	6	56	21	7	16	39	29
	91	7	14	54	52,4	7,5	6	5	39	35	6	27	19	46
B.	92	0	7	28	32,8	7,6	9	17	26	44	6	7	56	52
	93	4	16	51	38,2	7,8	0	16	9	59	5	18	37	9
	94	8	26	14	43,6	8,0	3	14	53	14	4	29	17	26
	1795	1	5	37	49,0	8,1	6	13	36	29	4	9	57	43
B.	96	5	28	11	29,4	8,3	9	25	23	38	3	20	34	49
	97	10	7	34	34,8	8,5	0	24	6	53	3	1	15	6
	98	2	16	57	40,2	8,6	3	22	50	8	2	11	55	23
	99	6	26	20	45,6	8,8	6	21	33	23	1	22	35	40
C.	1800	11	5	43	51,0	9,0	9	20	16	38	1	3	15	57
	1	3	15	6	56,4	9,2	0	18	59	52	0	13	56	14
	2	7	24	30	1,8	9,4	3	17	43	7	11	24	36	31
	3	0	3	53	7,2	9,6	6	16	26	22	11	5	16	48
B.	4	4	26	26	47,6	9,7	9	28	13	31	10	15	53	54
	1805	9	5	49	53,0	9,9	0	26	56	46	9	26	34	11
	6	1	15	12	58,4	10,1	3	25	40	1	9	7	14	28
	7	5	24	36	3,7	10,3	6	24	23	16	8	17	54	45
B.	8	10	17	9	44,2	10,5	10	6	10	25	7	28	31	51
	9	2	26	32	49,6	10,7	1	4	53	40	7	9	12	8
	1810	7	5	55	55,0	10,9	4	3	36	55	6	19	52	25
	11	11	15	19	0,3	11,1	7	2	20	9	6	0	32	42
B.	12	4	7	52	40,8	11,3	10	14	7	18	5	11	9	48
	13	8	17	15	46,2	11,5	1	12	50	33	4	21	50	5
	14	0	26	38	51,6	11,7	4	11	33	48	4	2	30	22
	1815	5	6	1	56,9	11,9	7	10	17	3	3	13	10	39
B.	16	9	28	35	37,4	12,1	10	22	4	12	2	23	47	45
	17	2	7	58	42,8	12,3	1	20	47	27	2	4	28	2
	18	6	17	21	48,2	12,5	4	19	30	42	1	15	8	19
	19	10	26	44	53,5	12,7	7	18	13	57	0	25	48	36
B.	1820	3	19	18	34,0	13,0	11	0	1	6	0	6	25	42
B.	40	8	2	53	17,0	17,6	0	9	45	34	11	9	35	27
B.	60	0	16	28	0,0	23,0	1	19	30	2	10	12	45	12
B.	1880	5	0	2	43,0	29,2	2	29	14	30	9	15	54	57

Epochs of the mean Motion of the Moon.
Mean Time for the Meridian of Philadelphia.

Years current.

Greg. Style. Yrs. ſince C.		Mean Long. ☽ s ° ′ ″	Accel. + ″	Mean Ano. ☽ s ° ′ ″	Long. ☊ s ° ′ ″
	1765	0 24 36 3,5	3,8	10 22 15 22	11 20 10 50
	66	5 3 59 8,9	3,9	1 21 58 37	11 0 51 7
	67	9 13 22 14,3	4,0	4 20 41 52	10 11 31 24
B.	68	2 5 55 54,7	4,2	8 2 29 1	9 22 8 30
	69	6 14 19 0,1	4,3	11 1 12 16	9 2 48 47
	1707	10 24 42 5,5	4,4	1 29 55 31	8 13 29 4
	71	3 4 5 10,9	4,5	4 28 38 45	7 24 9 21
B.	72	7 26 38 51,3	4,7	8 10 25 54	7 4 46 27
	73	0 6 1 56,7	4,8	11 7 9 9	6 15 26 44
	74	4 15 25 2,1	4,9	2 7 52 24	5 26 7 1
	1775	8 24 48 7,5	5,1	5 6 35 39	5 6 47 18
B.	76	1 17 21 47,9	5,2	8 18 22 48	4 17 24 24
	77	5 26 44 53,3	5,3	11 17 6 3	3 28 4 41
	78	10 6 7 58,7	5,5	2 15 49 18	3 8 44 58
	79	2 15 31 4,1	5,6	5 14 32 33	2 19 25 15
B.	1780	7 8 4 44,5	5,8	8 26 19 42	2 0 2 21
	81	11 17 27 49,9	5,9	11 25 2 56	1 10 42 38
	82	3 26 50 55,3	6,1	2 23 46 11	0 21 22 55
	83	8 6 14 0,7	6,2	5 22 29 26	0 2 3 12
B.	84	0 28 47 41,1	6,4	9 4 16 35	11 12 40 18
	1785	5 8 10 46,5	6,5	0 2 59 50	10 23 20 35
	86	9 17 33 51,9	6,7	3 1 43 5	10 4 0 52
	87	1 26 56 57,3	6,8	6 0 26 20	9 14 41 9
B.	88	6 18 30 37,7	7,0	9 12 13 29	8 25 18 15
	89	10 28 53 43,1	7,1	0 10 56 44	8 5 58 32
	1790	3 8 16 48,5	7,3	3 9 39 59	7 16 38 49
	91	7 17 39 53,9	7,5	6 8 23 13	6 27 19 6
B.	92	0 10 13 34,3	7,6	9 20 10 22	6 7 56 12
	93	4 19 36 39,7	7,8	0 18 53 37	5 18 36 29
	94	8 28 59 45,1	8,0	3 17 36 52	4 29 16 46
	1795	1 8 22 50,5	8,1	6 16 20 7	4 9 57 3
B.	96	6 0 56 30,9	8,3	9 28 7 16	3 20 34 9
	97	10 10 19 36,3	8,5	0 26 56 31	3 1 14 26
	98	2 19 42 41,7	8,6	3 25 33 46	2 11 54 43
	99	6 29 5 47,1	8,8	6 23 17 1	1 22 35 0
C.	1800	11 8 28 52,5	9,0	9 23 0 16	1 3 15 17
	1	3 17 51 57,9	9,2	0 21 43 30	0 13 55 34
	2	7 27 15 3,3	9,4	3 20 26 45	11 24 35 51
	3	0 6 38 8,7	9,6	6 19 10 0	11 5 16 8
B.	4	4 29 11 49,1	9,7	10 0 57 9	10 15 53 14
	1805	9 8 34 54,5	9,9	0 29 40 24	9 26 33 31
	6	1 17 57 59,9	10,1	3 28 23 39	9 7 13 58
	7	5 27 21 5,3	10,3	6 27 6 54	8 17 54 5
B.	8	10 19 54 45,7	10,5	10 8 54 3	7 28 31 11
	9	2 29 17 51,1	10,7	1 7 37 18	7 9 11 29
	1810	7 8 40 56,5	10,9	4 6 20 33	6 19 51 45
	11	11 18 4 1,8	11,1	7 5 3 47	6 0 32 2
B.	12	4 10 37 42,3	11,3	10 16 50 56	5 11 9 8
	13	8 20 0 47,7	11,5	1 15 34 11	4 21 49 25
	14	0 29 23 53,1	11,7	4 14 17 26	4 2 29 52
	1815	5 8 46 58,4	11,9	7 13 0 41	3 13 9 59
B.	16	10 1 20 38,9	12,1	10 24 47 50	2 23 47 5
	17	2 10 43 44,3	12,3	1 23 31 5	2 4 27 22
	18	6 20 6 49,7	12,5	4 22 14 20	1 15 7 39
	19	10 29 29 55,0	12,7	7 20 57 35	0 25 47 56
B.	1820	3 22 3 35,5	13,0	11 2 44 44	0 6 25 2
	21	8 1 26 41,9	13,2	2 1 27 59	11 17 5 19
	22	0 10 49 47,3	13,4	5 0 11 14	10 27 45 56
	23	4 20 12 52,7	13,6	7 28 54 29	10 8 25 53
B.	24	9 12 46 33,1	13,8	11 10 41 38	9 19 2 19
	1825	1 22 9 38,5	14,1	2 9 24 53	8 29 43 36
	26	6 1 32 43,9	14,3	5 8 8 8	8 10 23 53
	27	10 10 55 49,3	14,5	8 6 51 22	7 21 3 50
B.	1828	3 3 29 29,7	14,7	11 18 38 31	7 1 40 56
	29	7 12 52 35,1	14,9	2 17 21 46	6 12 21 13
	30	11 22 15 40,5	15,2	5 16 5 1	5 23 1 30
	31	4 1 38 45,9	15,4	8 14 48 16	5 3 41 47
B.	32	8 24 12 26,3	15,6	11 26 35 25	4 14 18 53
	33	1 3 35 31,7	15,8	2 25 18 40	3 24 59 10
	34	5 12 58 36,1	16,1	5 24 1 54	3 5 39 27

Mean motion of the Moon in Years.

Ju. Years.		Long. ☽ s ° ′ ″ ‴	Mean Anom. ☽ s ° ′ ″ ‴	Motion ☊ ☽ Retro. s ° ′ ″ ‴
	1	4 9 23 5 23,5	2 28 43 14 54,5	0 19 19 43 5,5
	2	8 18 46 10 47,0	5 27 26 29 49,0	1 8 39 26 11,0
	3	0 28 9 16 10,5	8 26 9 44 43,5	1 27 59 9 16,5
B.	4	5 20 42 56 36,0	0 7 56 53 36,0	2 17 22 3 0,5
	5	10 0 6 1 59,5	3 6 40 8 30,5	3 6 41 46 6,0
	6	2 9 29 7 23,0	6 5 23 23 25,0	3 26 1 29 11,5
	7	6 18 52 12 45,5	9 4 6 38 19,5	4 15 21 12 17,0
B.	8	11 11 25 53 12,0	0 15 53 47 12,0	5 4 44 6 1,0
	9	3 20 48 58 35,5	3 14 37 2 6,5	5 24 3 49 6,5
	10	8 0 12 3 59,0	6 13 20 17 1,0	6 13 23 32 12,0
B.	20	4 13 34 43 8,0	1 9 44 28 0,0	0 26 50 15 0,0
B.	40	8 27 9 26 0,0	2 19 28 56 0,0	1 23 40 30 0,0
B.	60	1 10 44 9 0,0	3 29 13 24 0,0	2 20 30 45 0,0
B.	80	5 24 18 52 0,0	5 8 57 52 0,0	3 17 21 0 0,0
B.	100	10 7 53 35 0,0	6 18 42 20 0,0	4 14 11 15 0,0

Moon's mean motion for Months and Days.

JANUARY.

Days.	Mean motion ☽ s ° ′ ″	Mean motion Ano. s ° ′ ″	Mean Mo. ☊ ° ′ ″
1	0 13 10 35,0	0 13 3 54,0	0 3 10,6
2	0 26 21 10,1	0 26 7 47,9	0 6 21,3
3	1 9 31 45,1	1 9 11 41,9	0 9 31,9
4	1 22 42 20,1	1 22 15 35,8	0 12 42,6
5	2 5 52 55,1	2 5 19 29,8	0 15 53,2
6	2 19 3 30,2	2 18 23 23,8	0 19 3,8
7	3 2 14 5,2	3 1 27 17,7	0 22 14,5
8	3 15 24 40,2	3 14 31 11,7	0 25 25,1
9	3 28 35 15,3	3 27 35 5,6	0 28 35,8
10	4 11 45 50,3	4 10 38 59,6	0 31 46,4
11	4 24 56 25,3	4 23 42 53,5	0 34 57,0
12	5 8 7 0,3	5 6 46 47,5	0 38 7,7
13	5 21 17 35,4	5 19 50 41,5	0 41 18,3
14	6 4 28 10,4	6 2 54 35,4	0 44 29,0
15	6 17 38 45,4	6 15 58 29,4	0 47 39,6
16	7 0 49 20,5	6 29 2 23,3	0 50 50,2
17	7 13 59 55,5	7 12 6 17,3	0 54 0,9
18	7 27 10 30,5	7 25 10 11,3	0 57 11,5
19	8 10 21 5,5	8 8 14 5,2	1 0 22,1
20	8 23 31 40,6	8 21 17 59,2	1 3 32,8
21	9 6 42 15,6	9 4 21 53,1	1 6 43,4
22	9 19 52 50,6	9 17 25 47,1	1 9 54,5
23	10 3 3 25,7	10 0 29 41,1	1 13 4,7
24	10 16 14 0,7	10 13 33 35,0	1 16 15,3
25	10 29 24 35,7	10 26 37 29,0	1 19 26,0
26	11 12 35 10,7	11 9 41 22,9	1 22 36,6
27	11 25 45 45,8	11 22 45 16,9	1 25 47,3
28	0 8 56 20,8	0 5 49 10,8	1 28 57,9
29	0 22 6 55,8	0 18 53 4,8	1 32 8,5
30	1 5 17 30,9	1 1 56 58,8	1 35 19,2
31	1 18 28 5,9	1 15 0 52,7	1 38 29,8

MOON's mean Motion for Months and Days.

February.

Days.	Mean motion ☽				Mo. mean Ano.				Me. Mo. ☊		
	s	°	′	″	s	°	′	″	°	′	″
1	2	1	38	40,9	1	28	4	46,7	1	41	40,4
2	2	14	49	15,9	2	11	8	40,6	1	44	51,1
3	2	27	59	51,0	2	24	12	34,6	1	48	1,7
4	3	11	10	26,0	3	7	16	28,6	1	51	12,4
5	3	24	21	1,0	3	20	20	22,5	1	54	23,0
6	4	7	31	36,1	4	3	24	16,5	1	57	33,6
7	4	20	42	11,1	4	16	28	10,4	2	0	44,3
8	5	3	52	46,1	4	29	32	4,4	2	3	54,9
9	5	17	3	21,1	5	12	35	58,3	2	7	5,5
10	6	0	13	56,2	5	25	39	52,3	2	10	16,2
11	6	13	24	31,2	6	8	43	46,3	2	13	26,8
12	6	26	35	6,2	6	21	47	40,2	2	16	37,5
13	7	9	45	41,3	7	4	51	34,2	2	19	48,1
14	7	22	56	16,3	7	17	55	28,1	2	22	58,7
15	8	6	6	51,3	8	0	59	22,1	2	26	9,4
16	8	19	17	26,3	8	14	3	16,1	2	29	20,0
17	9	2	28	1,4	8	27	7	10,0	2	32	30,7
18	9	15	38	36,4	9	10	11	4,0	2	35	41,3
19	9	28	49	11,4	9	23	14	57,9	2	38	51,9
20	10	11	59	46,5	10	6	18	51,9	2	42	2,6
21	10	25	10	21,5	10	19	22	45,9	2	45	13,2
22	11	8	20	56,5	11	2	26	39,8	2	48	23,8
23	11	21	31	31,5	11	15	30	33,8	2	51	34,5
24	0	4	42	6,6	11	28	34	27,7	2	54	45,1
25	0	17	52	41,6	0	11	38	21,7	2	57	55,8
26	1	1	3	16,6	0	24	42	15,6	3	1	6,4
27	1	14	13	51,7	1	7	46	9,6	3	4	17,0
28	1	27	24	26,7	1	20	50	3,6	3	7	27,7

*** In the Months January and February of a Bissextile Year, subtract 1 from the Number of Days given.

March.

Days.	Mean motion ☽				Mo. mean Ano.				Me. Mo. ☊		
	s	°	′	″	s	°	′	″	°	′	″
1	2	10	35	1,7	2	3	53	57,5	3	10	38,3
2	2	23	45	36,7	2	16	57	51,5	3	13	49,0
3	3	6	56	11,8	3	0	1	45,4	3	16	59,6
4	3	20	6	46,8	3	13	5	39,4	3	20	10,2
5	4	3	17	21,8	3	26	9	33,4	3	23	20,9
6	4	16	27	56,9	4	9	13	27,3	3	26	31,5
7	4	29	38	31,9	4	22	17	21,3	3	29	42,1
8	5	12	49	6,9	5	5	21	15,2	3	32	52,8
9	5	25	59	41,9	5	18	25	9,2	3	36	3,4
10	6	9	10	17,0	6	1	29	3,1	3	39	14,1
11	6	22	20	52,0	6	14	32	57,1	3	42	24,7
12	7	5	31	27,0	6	27	36	51,1	3	45	35,3
13	7	18	42	2,1	7	10	40	45,0	3	48	46,0
14	8	1	52	37,1	7	23	44	39,0	3	51	56,6
15	8	15	3	12,1	8	6	48	32,9	3	55	7,3
16	8	28	13	47,1	8	19	52	26,9	3	58	17,9
17	9	11	24	22,2	9	2	56	20,9	4	1	28,5
18	9	24	34	57,2	9	16	0	14,8	4	4	39,2
19	10	7	45	32,2	9	29	4	8,8	4	7	49,8
20	10	20	56	7,3	10	12	8	2,7	4	11	0,4
21	11	4	6	42,3	10	25	11	56,7	4	14	11,1
22	11	17	17	17,3	11	8	15	50,7	4	17	21,7
23	0	0	27	52,3	11	21	19	44,6	4	20	32,4
24	0	13	38	27,4	0	4	23	38,6	4	23	43,0
25	0	26	49	2,4	0	17	27	32,5	4	26	53,6
26	1	9	59	37,4	1	0	31	26,5	4	30	4,3
27	1	23	10	12,5	1	13	35	20,4	4	33	14,9
28	2	6	20	47,5	1	26	39	14,4	4	36	25,5
29	2	19	31	22,5	2	9	43	8,4	4	39	36,2
30	3	2	41	57,5	2	22	47	2,3	4	42	46,8
31	3	15	52	32,6	3	5	50	56,3	4	45	57,5

April.

Days.	Mean motion ☽				Mo. mean Ano.				Me. mo. ☊		
	s	°	′	″	s	°	′	″	°	′	″
1	3	29	3	7,6	3	18	54	50,2	4	49	8,1
2	4	12	13	42,6	4	1	58	44,2	4	52	18,7
3	4	25	24	17,7	4	15	2	38,2	4	55	29,4
4	5	8	34	52,7	4	28	6	32,1	4	58	40,0
5	5	21	45	27,7	5	11	10	26,1	5	1	50,7
6	6	4	56	2,7	5	24	14	20,0	5	5	1,3
7	6	18	6	37,8	6	7	18	14,0	5	8	11,9
8	7	1	17	12,8	6	20	22	7,9	5	11	22,6
9	7	14	27	47,8	7	3	26	1,9	5	14	33,2
10	7	27	38	22,9	7	16	29	55,9	5	17	43,9
11	8	10	48	57,9	7	29	33	49,8	5	20	54,5
12	8	23	59	32,9	8	12	37	43,8	5	24	5,1
13	9	7	10	7,9	8	25	41	37,7	5	27	15,8
14	9	20	20	43,0	9	8	45	31,7	5	30	26,4
15	10	3	31	18,0	9	21	49	25,7	5	33	37,1
16	10	16	41	53,0	10	4	53	19,6	5	36	47,7
17	10	29	52	28,0	10	17	57	13,6	5	39	58,3
18	11	13	3	3,1	11	1	1	7,5	5	43	9,0
19	11	26	13	38,1	11	14	5	1,5	5	46	19,6
20	0	9	24	13,1	11	27	8	55,5	5	49	30,3
21	0	22	34	48,2	0	10	12	49,4	5	52	40,9
22	1	5	45	23,2	0	23	16	43,4	5	55	51,5
23	1	18	55	58,2	1	6	20	37,3	5	59	2,2
24	2	2	6	33,2	1	19	24	31,3	6	2	12,8
25	2	15	17	8,3	2	2	28	25,2	6	5	23,4
26	2	28	27	43,3	2	15	32	19,2	6	8	34,1
27	3	11	38	18,3	2	28	36	13,2	6	11	44,7
28	3	24	48	53,4	3	11	40	7,1	6	14	55,4
29	4	7	59	28,4	3	24	44	1,1	6	18	6,0
30	4	21	10	3,4	4	7	47	55,0	6	21	16,6

May.

Days.	Mean motion ☽				Mo. mean Ano.				Mo. Me. ☊		
	s	°	′	″	s	°	′	″	°	′	″
1	5	4	20	38,4	4	20	51	49,0	6	24	27,3
2	5	17	31	13,5	5	3	55	43,0	6	27	37,9
3	6	0	41	48,5	5	16	59	36,9	6	30	48,5
4	6	13	52	23,5	6	0	3	30,9	6	33	59,2
5	6	27	2	58,6	6	13	7	24,8	6	37	9,8
6	7	10	13	33,6	6	26	11	18,8	6	40	20,5
7	7	23	24	8,6	7	9	15	12,8	6	43	31,1
8	8	6	34	43,6	7	22	19	6,7	6	46	41,7
9	8	19	45	18,7	8	5	23	0,7	6	49	52,4
10	9	2	55	53,7	8	18	26	54,6	6	53	3,0
11	9	16	6	28,7	9	1	30	48,6	6	56	13,7
12	9	29	17	3,8	9	14	34	42,5	6	59	24,3
13	10	12	27	38,8	9	27	38	36,5	7	2	34,9
14	10	25	38	13,8	10	10	42	30,5	7	5	45,6
15	11	8	48	48,8	10	23	46	24,4	7	8	56,2
16	11	21	59	23,9	11	6	50	18,4	7	12	6,8
17	0	5	9	58,9	11	19	54	12,3	7	15	17,5
18	0	18	20	33,9	0	2	58	6,3	7	18	28,1
19	1	1	31	9,0	0	16	2	0,2	7	21	38,8
20	1	14	41	44,0	0	29	5	54,2	7	24	49,4
21	1	27	52	19,0	1	12	9	48,2	7	28	0,0
22	2	11	2	54,0	1	25	13	42,1	7	31	10,7
23	2	24	13	29,1	2	8	17	36,1	7	34	21,3
24	3	7	24	4,1	2	21	21	30,0	7	37	32,0
25	3	20	34	39,1	3	4	25	24,0	7	40	42,6
26	4	3	45	14,2	3	17	29	17,9	7	43	53,2
27	4	16	55	49,2	4	0	33	11,9	7	47	3,9
28	5	0	6	24,2	4	13	37	5,9	7	50	14,5
29	5	13	16	59,2	4	26	40	59,8	7	53	25,1
30	5	26	27	34,3	5	9	44	53,8	7	56	35,8
31	6	9	38	9,3	5	22	48	47,7	7	59	46,4

MOON's Mean Motion for Months and Days.

June.

Days.	Mean motion ☽				Mo. mean Ano.				Mea. mo. ☊		
	s	°	′	″	s	°	′	″	°	′	″
1	6	22	48	44,3	6	5	52	41,7	8	2	57,1
2	7	5	59	19,4	6	18	56	35,7	8	6	7,7
3	7	19	9	54,4	7	2	0	29,6	8	9	18,3
4	8	2	20	29,4	7	15	4	23,6	8	12	29,0
5	8	15	31	4,4	7	28	8	17,5	8	15	39,6
6	8	28	41	39,5	8	11	12	11,5	8	18	50,2
7	9	11	52	14,5	8	24	16	5,4	8	22	0,9
8	9	25	2	49,5	9	7	19	59,4	8	25	11,5
9	10	8	13	24,6	9	20	23	53,4	8	28	22,2
10	10	21	23	59,6	10	3	27	47,3	8	31	32,8
11	11	4	34	34,6	10	16	31	41,3	8	34	43,4
12	11	17	45	9,6	10	29	35	35,2	8	37	54,1
13	0	0	55	44,7	11	12	39	29,2	8	41	4,7
14	0	14	6	19,7	11	25	43	23,2	8	44	15,4
15	0	27	16	54,7	0	8	47	17,1	8	47	26,0
16	1	10	27	29,8	0	21	51	11,1	8	50	36,6
17	1	23	38	4,8	1	4	55	5,0	8	53	47,3
18	2	6	48	39,8	1	17	58	59,0	8	56	57,9
19	2	19	59	14,8	2	1	2	53,0	9	0	8,5
20	3	3	9	49,9	2	14	6	46,9	9	3	19,2
21	3	16	20	24,9	2	27	10	40,9	9	6	29,8
22	3	29	30	59,9	3	10	14	34,8	9	9	40,5
23	4	12	41	35,0	3	23	18	28,8	9	12	51,1
24	4	25	52	10,0	4	6	22	22,7	9	16	1,7
25	5	9	2	45,0	4	19	26	16,7	9	19	12,4
26	5	22	13	20,0	5	2	30	10,7	9	22	23,0
24	6	5	23	55,1	5	15	34	4,6	9	25	33,7
28	6	18	34	30,1	5	28	37	58,6	9	28	44,3
29	7	1	45	5,1	6	11	41	52,5	9	31	54,9
30	7	14	55	40,2	6	24	45	46,5	9	35	5,6

July.

Days.	Mean motion ☽				Mo. mean Ano.				Mea. Mo. ☊		
	s	°	′	″	s	°	′	″	°	′	″
1	7	28	6	15,2	7	7	49	40,5	9	38	16,2
2	8	11	16	50,2	7	20	53	34,4	9	41	26,9
3	8	24	27	25,2	8	3	57	28,4	9	44	37,5
4	9	7	38	0,3	8	17	1	22,3	9	47	48,1
5	9	20	48	35,3	9	0	5	16,3	9	50	58,8
6	10	3	59	10,3	9	13	9	10,3	9	54	9,4
7	10	17	9	45,4	9	26	13	4,2	9	57	20,0
8	11	0	20	20,4	10	9	16	58,2	10	0	30,7
9	11	13	30	55,4	10	22	20	52,1	10	3	41,3
10	11	26	41	30,4	11	5	24	46,1	10	6	52,0
11	0	9	52	5,5	11	18	28	40,0	10	10	2,6
12	0	23	2	40,5	0	1	32	34,0	10	13	13,2
13	1	6	13	15,5	0	14	36	28,0	10	16	23,9
14	1	19	23	50,6	0	27	40	21,0	10	19	34,5
15	2	2	34	25,6	1	10	44	15,9	10	22	45,2
16	2	15	45	0,6	1	23	48	9,8	10	25	55,8
17	2	28	55	35,6	2	6	52	3,8	10	29	6,4
18	3	12	6	10,7	2	19	55	57.8	10	32	17,1
19	3	25	16	45,7	3	2	59	51,7	10	35	27,7
20	4	8	27	20,7	3	16	3	45,7	10	38	38,4
21	4	21	37	55,8	3	29	7	39,6	10	41	49,0
22	5	4	48	30,8	4	12	11	33,6	10	44	59,6
23	5	17	59	5,8	4	25	15	27,5	10	48	10,3
24	6	1	9	40,8	5	8	19	21,5	10	51	20,9
25	6	14	20	15,9	5	21	23	15,5	10	54	31,6
26	6	27	30	50,9	6	4	27	9,4	10	57	42,2
27	7	10	41	25,9	6	17	31	3,4	11	0	52,8
28	7	23	52	1,0	7	0	34	57,3	11	4	3,5
29	8	7	2	36,0	7	13	38	51,3	11	7	14,1
30	8	20	13	11,0	7	26	42	45,3	11	10	24,7
31	9	3	23	46,0	8	9	46	39,2	11	13	35,4

August.

Days.	Mean motion ☽				Mo. mean Ano.				Mea. mo. ☊		
	s	°	′	″	s	°	′	″	°	′	″
1	9	16	34	21,1	8	22	50	33,2	11	16	46,0
2	9	29	44	56,1	9	5	54	27,1	11	19	56,7
3	10	12	55	31,1	9	18	58	21,1	11	23	7,3
4	10	26	6	6,2	10	2	2	15,1	11	26	17,9
5	11	9	16	41,2	10	15	6	9,0	11	29	28,6
6	11	22	27	16,2	10	28	10	3,0	11	32	39,2
7	0	5	37	51,2	11	11	13	56,9	11	35	49,9
8	0	18	48	26,3	11	24	17	50,9	11	39	0,5
9	1	1	59	1,3	0	7	21	44,8	11	42	11,1
10	1	15	9	36,3	0	20	25	38,8	11	45	21,8
11	1	28	20	11,4	1	3	29	32,8	11	48	32,4
12	2	11	30	46,4	1	16	33	26,7	11	51	43,1
13	2	24	41	21,4	1	29	37	20,7	11	54	53,7
14	3	7	51	56,4	2	12	41	14,6	11	58	4,3
15	3	21	2	31,5	2	25	45	8,6	12	1	15,0
16	4	4	13	6,5	3	8	49	2,6	12	4	25,6
17	4	17	23	41,5	3	21	52	56,5	12	7	36,2
18	5	0	34	16,6	4	4	56	50,5	12	10	46,9
19	5	13	44	51,6	4	18	0	44,4	12	13	57,5
20	5	26	55	26,6	5	1	4	38,4	12	17	8,2
21	6	10	6	1,6	5	14	8	32,3	12	20	18,8
22	6	23	16	36,7	5	27	12	26,3	12	23	29,4
23	7	6	27	11,7	6	10	16	20,3	12	26	40,1
24	7	19	37	46,7	6	23	20	14,2	12	29	50,7
25	8	2	48	21,8	7	6	24	8,2	12	33	1,4
26	8	15	58	56,8	7	19	28	2,1	12	36	12,0
27	8	29	9	31,8	8	2	31	56,1	12	39	22,6
28	9	12	20	6,8	8	15	35	50,1	12	42	33,3
29	9	25	30	41,9	8	28	39	44,0	12	45	43,9
30	10	8	41	16,9	9	11	43	38,0	12	48	54,5
31	10	21	51	51,9	9	24	47	31,9	12	52	5,2

September.

Days.	Mean motion ☽				Mo. mean Ano.				Mea. mo. ☊		
	s	°	′	″	s	°	′	″	°	′	″
1	11	5	2	27,0	10	7	51	25,9	12	55	15,8
2	11	18	13	2,0	10	20	55	19,9	12	58	26,5
3	0	1	23	37,0	11	3	59	13,8	13	1	37,1
4	0	14	34	12,0	11	17	3	7,8	13	4	47,7
5	0	27	44	47,1	0	0	7	1,7	13	7	58,4
6	1	10	55	22,1	0	13	10	55,7	13	11	9,0
7	1	24	5	57,1	0	26	14	49,6	13	14	19,7
8	2	7	16	32,2	1	9	18	43,6	13	17	30,3
9	2	20	27	7,2	1	22	22	37,6	13	20	40,9
10	3	3	37	42,2	2	5	26	31,5	13	23	51,6
11	3	16	48	17,2	2	18	30	25,5	13	27	2,2
12	3	29	58	52,3	3	1	34	19,4	13	30	12,9
13	4	13	9	27,3	3	14	38	13,4	13	33	23,5
14	4	26	20	2,3	3	27	42	7,4	13	36	34,1
15	5	9	30	37,4	4	10	46	1,3	13	39	44,8
16	5	22	41	12,4	4	23	49	55,3	13	42	55,4
17	6	5	51	47,4	5	6	53	49,2	13	46	6,0
18	6	19	2	22,4	5	19	57	43,2	13	49	16,7
19	7	2	12	57,5	6	3	1	37,2	13	52	27,3
20	7	15	23	32,5	6	16	5	31,1	13	55	38,0
21	7	28	34	7,5	6	29	9	25,1	13	58	48,6
22	8	11	44	42,6	7	12	13	19,0	14	1	59,2
23	8	24	55	17,6	7	25	17	13,0	14	5	9,9
24	9	8	5	52,6	8	8	21	6,9	14	8	20,5
25	9	21	16	27,6	8	21	25	0,9	14	11	31,1
26	10	4	27	2,7	9	4	28	54,9	14	14	41,8
27	10	17	37	37,7	9	17	32	48,8	14	17	52,4
28	11	0	48	12,7	10	0	36	42,8	14	21	3,1
29	11	13	58	47,8	10	13	40	36,7	14	24	13,7
30	11	27	9	22,8	10	26	44	30,7	14	27	24,3

MOON's Mean Motion for Months, Days and Hours.

OCTOBER.

Days.	Mean motion ☽				Mo. mean Ano.				Mea. mo. ☊		
	s	°	'	"	s	°	'	"	°	'	"
1	0	10	19	57,8	11	9	48	24,7	14	30	35,0
2	0	23	30	32,8	11	22	52	18,6	14	33	45,6
3	1	6	41	7,9	0	5	56	12,6	14	36	56,3
4	1	19	51	42,9	0	19	0	6,5	14	40	6,9
5	2	3	2	17,9	1	2	4	0,5	14	43	17,5
6	2	16	12	53,0	1	15	7	54,4	14	46	28,2
7	2	29	23	28,0	1	28	11	48,4	14	49	38,8
8	3	12	34	3,0	2	11	15	42,4	14	52	49,4
9	3	25	44	38,0	2	24	19	36,3	14	56	0,1
10	4	8	55	13,1	3	7	23	30,3	14	59	10,7
11	4	22	5	48,1	3	20	27	24,2	15	2	21,4
12	5	5	16	23,1	4	3	31	18,2	15	5	32,0
13	5	18	26	58,1	4	16	35	12,2	15	8	42,6
14	6	1	37	33,2	4	29	39	6,1	15	11	53,3
15	6	14	48	8,2	5	12	43	0,1	15	15	3,9
16	6	27	58	43,2	5	25	46	54,0	15	18	14,6
17	7	11	9	18,3	6	8	50	48,0	15	21	25,2
18	7	24	19	53,3	6	21	54	42,0	15	24	35,8
19	8	7	30	28,3	7	4	58	35,9	15	27	46,5
20	8	20	41	3,3	7	18	2	29,9	15	30	57,1
21	9	3	51	38,4	8	1	6	23,8	15	34	7,8
22	9	17	2	13,4	8	14	10	17,8	15	37	18,4
23	10	0	12	48,4	8	27	14	11,7	15	40	29,0
24	10	13	23	23,5	9	10	18	5,7	15	43	39,7
25	10	26	33	58,5	9	23	21	59,7	15	46	50,3
26	11	9	44	33,5	10	6	25	53,6	15	50	0,9
27	11	22	55	8,5	10	19	29	47,6	15	53	11,6
28	0	6	5	43,6	11	2	33	41,5	15	56	22,2
29	0	19	16	18,6	11	15	37	35,5	15	59	32,9
30	1	2	26	53,6	11	28	41	29.5	16	2	43,5
31	1	15	37	28,7	0	11	45	23,4	16	5	54,1

NOVEMBER.

Days.	Mean motion ☽				Mo. mean Ano.				Mea. Mo. ☊		
	s	°	'	"	s	°	'	"	°	'	"
1	1	28	48	3,7	0	24	49	17,4	16	9	4,8
2	2	11	58	38,7	1	7	53	11,3	16	12	15,4
3	2	25	9	13,7	1	20	57	5,3	16	15	26,1
4	3	8	19	48,8	2	4	0	59,2	16	18	36,7
5	3	21	30	23,8	2	17	4	53,2	16	21	47,3
6	4	4	40	58,8	3	0	8	47,2	16	24	58,0
7	4	17	51	33,9	3	13	12	41,1	16	28	8,6
8	5	1	2	8,9	3	26	16	35,1	16	31	19,3
9	5	14	12	43,9	4	9	20	29,0	16	34	29,9
10	5	27	23	18,9	4	22	24	23,0	16	37	40,5
11	6	10	33	54,0	5	5	28	17,0	16	40	51,2
12	6	23	44	29,0	5	18	32	10,9	16	44	1,8
13	7	6	55	4,0	6	1	36	4,9	16	47	12,4
14	7	20	5	39,1	6	14	39	58,8	16	50	23,1
15	8	3	16	14,1	6	27	43	52,8	16	53	33,7
16	8	16	26	49,1	7	10	47	46,8	16	56	44,4
17	8	29	37	24,1	7	23	51	40,7	16	59	55,0
18	9	12	47	59,2	8	6	55	34,7	17	3	5,6
19	9	25	58	34,2	8	19	59	28,6	17	6	16,3
20	10	9	9	9,2	9	3	3	22,6	17	9	26,9
21	10	22	19	44,3	9	16	7	16,5	17	12	37,6
22	11	5	30	19,3	9	29	11	10,5	17	15	48,2
23	11	18	40	54,3	10	12	15	4,5	17	18	58,8
24	0	1	51	29,3	10	25	18	58,4	17	22	9,5
25	0	15	2	4,4	11	8	22	52,4	17	25	20,1
26	0	28	12	39,4	11	21	26	46,3	17	28	30,7
27	1	11	23	14,4	0	4	30	40,3	17	31	41,4
28	1	24	33	49,5	0	17	34	34,3	17	34	52,0
29	2	7	44	24,5	1	0	38	28,2	17	38	2,7
30	2	20	54	59,5	1	13	42	22,2	17	41	13,3

DECEMBER.

Days.	Mean motion ☽				Mo. mean Ano.				Mea. mo. ☊		
	s	°	'	"	s	°	'	"	°	'	"
1	3	4	5	34,5	1	26	46	16,1	17	44	23,9
2	3	17	16	9,6	2	9	50	10,1	17	47	34,6
3	4	0	26	44,6	2	22	54	4,1	17	50	45,2
4	4	13	37	19,6	3	5	57	58,0	17	53	55,9
5	4	26	47	54,7	3	19	1	52,0	17	57	6,5
6	5	9	58	29,7	4	2	5	45,9	18	0	17,1
7	5	23	9	4,7	4	15	9	39,9	18	3	27,8
8	6	6	19	39,7	4	28	13	33,8	18	6	38,4
9	6	19	30	14,8	5	11	17	27,8	18	9	49,1
10	7	2	40	49,8	5	24	21	21,8	18	12	59,7
11	7	15	51	24,8	6	7	25	15,7	18	16	10,3
12	7	29	1	59,9	6	20	29	9,7	18	19	21,0
13	8	12	12	34,9	7	3	33	3,6	18	22	31,6
14	8	25	23	9,9	7	16	36	57,6	18	25	42,2
15	9	8	33	44,9	7	29	40	51,5	18	28	52,9
16	9	21	44	20,0	8	12	44	45,5	18	32	3,5
17	10	4	54	55,0	8	25	48	39,5	18	35	14,2
18	10	18	5	30,0	9	8	52	33,4	18	38	24,8
19	11	1	16	5,1	9	21	56	27,4	18	41	35,4
20	11	14	26	40,1	10	5	0	21,3	18	44	46,1
21	11	27	37	15,1	10	18	4	15,3	18	47	56,7
22	0	10	47	50,1	11	1	8	9,3	18	51	7,4
23	0	23	58	25,2	11	14	12	3,2	18	54	18 0
24	1	7	9	0,2	11	27	15	57,2	18	57	28 6
25	1	20	19	35,2	0	10	19	51,1	19	0	39 3
26	2	3	30	10,3	0	23	23	45,1	19	3	49 9
27	2	16	40	45,3	1	6	27	39,1	19	7	0 5
28	2	29	51	20,3	1	19	31	33,0	19	10	11,2
29	3	13	1	55,3	2	2	35	27,0	19	13	21,8
30	3	26	12	30,4	2	15	39	20,9	19	16	32,5
31	4	9	23	5,4	2	28	43	14,9	19	19	43,1

For HOURS.

Hrs.	Longitude ☽			Anomaly.			☊	
	°	'	"	°	'	"	'	"
1	0	32	56,5	0	32	39,7	0	7,9
2	1	5	52,9	1	5	19,5	0	15,9
3	1	38	49,4	1	37	59,2	0	23,8
4	2	11	45,8	2	10	39,0	0	31,8
5	2	44	42,3	2	43	18,7	0	39,7
6	3	17	38,8	3	15	58,5	0	47,7
7	3	50	35,2	3	48	38,2	0	55,6
8	4	23	31,7	4	21	18,0	1	3,6
9	4	56	28,1	4	53	57,7	1	11,5
10	5	29	24,6	5	26	37,5	1	19,4
11	6	2	21,1	5	59	17,2	1	27,4
12	6	35	17,5	6	31	57,0	1	35,3
13	7	8	14,0	7	4	36,7	1	43,3
14	7	41	10,4	7	37	16,5	1	51,2
15	8	14	6,9	8	9	56,2	1	59,2
16	8	47	3,4	8	42	36,0	2	7,1
17	9	19	59,8	9	15	15,7	2	15,0
18	9	52	56,3	9	47	55,5	2	23,0
19	10	25	52,7	10	20	35,2	2	30,9
20	10	58	49,2	10	53	15,0	2	38,9
21	11	31	45,6	11	25	54,7	2	46,8
22	12	4	42,1	11	58	34,5	2	54,8
23	12	37	38,6	12	31	14,2	3	2,7
24	13	10	35,0	13	3	54,0	3	10,6
25	13	43	31,5	13	36	33,7	3	18,6
26	14	16	27,9	14	9	13,5	3	26,5
27	14	49	24,4	14	41	53,2	3	34,5
28	15	22	20,9	15	14	33,0	3	42,4
29	15	55	17,3	15	47	12,7	3	50,4
30	16	28	13,8	16	19	52,4	3	58,3

Moon's mean motion for Minutes & Seconds.

′ / ″	Lon. ☽ ′ ″ / ″ ‴		Anom. ′ ″ / ″ ‴		☊ ″ / ‴
1	0	32,9	0	32,7	0,1
2	1	5,9	1	5,3	0,3
3	1	38,8	1	38,0	0,4
4	2	11,8	2	10,6	0,5
5	2	44,7	2	43,3	0,7
6	3	17,6	3	16,0	0,8
7	3	50,6	3	48,6	0,9
8	4	23,5	4	21,3	1,1
9	4	56,5	4	54,0	1,2
10	5	29,4	5	26,6	1,3
11	6	2,4	5	59,3	1,5
12	6	35,3	6	31,9	1,6
13	7	8,2	7	4,6	1,7
14	7	41,2	7	37,3	1,9
15	8	14,1	8	9,9	2,0
16	8	47,1	8	42,6	2,1
17	9	20,0	9	15,3	2,3
18	9	52,9	9	47,9	2,4
19	10	25,9	10	20,6	2,5
20	10	58,8	10	53,2	2,6
21	11	31,8	11	25,9	2,8
22	12	4,7	11	58,6	2,9
23	12	37,6	12	31,2	3,0
24	13	10,6	13	3,9	3,2
25	13	43,5	13	36,6	3,3
26	14	16,5	14	9,2	3,4
27	14	49,4	14	41,9	3,6
28	15	22,3	15	14,5	3,7
29	15	55,3	15	47,2	3,8
30	16	28,2	16	19,9	4,0
31	17	1,2	16	52,5	4,1
32	17	34,1	17	25,2	4,2
33	18	7,1	17	57,9	4,4
34	18	40,0	18	30,5	4,5
35	19	12,9	19	3,2	4,6
36	19	45,9	19	35,8	4,8
37	20	18,8	20	8,[illegible]	4,9
38	20	51,8	20	41,2	5,0
39	21	24,7	21	13,[illegible]	5,2
40	21	57,6	21	46,[illegible]	5,3
41	22	30,6	22	19,2	5,4
42	23	3,5	22	51,8	5,6
43	23	36,5	23	24,5	5,7
44	24	9,4	23	57,1	5,8
45	24	42,3	24	29,8	6,0
46	25	15,3	25	2,5	6,1
47	25	48,2	25	35,1	6,2
48	26	21,2	26	7,8	6,4
49	26	54,1	26	40,5	6,5
50	27	27,0	27	13,1	6,6
51	28	0,0	27	45,8	6,8
52	28	32,9	28	18,5	6,9
53	29	5,9	28	51,1	7,0
54	29	38,8	29	23,8	7,1
55	30	11,8	29	56,4	7,3
56	30	44,7	30	29,1	7,4
57	31	17,6	31	1,8	7,5
58	31	50,6	31	34,4	7,7
59	32	23,5	32	7,1	7,8
60	32	56,5	32	39,8	7,9

Annual Equation of MOON's Node.

Argument. Sun's Mean Anomaly.

S	0 + ′	″	Diff. ″	1 + ′	″	Diff. ″	2 + ′	″	Diff. ″	S
0	0	0	9	4	30	8	7	52	5	30
1	0	9	10	4	38	8	7	57	4	29
2	0	19	9	4	46	8	8	1	5	28
3	0	28	10	4	54	8	8	6	5	27
4	0	38	9	5	2	8	8	11	4	26
5	0	47	9	5	10	8	8	15	4	25
6	0	56	10	5	18	8	8	19	4	24
7	1	6	9	5	26	7	8	23	4	23
8	1	15	9	5	33	8	8	27	4	22
9	1	24	10	5	41	7	8	31	3	21
10	1	34	9	5	48	7	8	34	3	20
11	1	43	9	5	55	7	8	37	4	19
12	1	52	9	6	2	8	8	41	3	18
13	2	1	9	6	10	7	8	44	3	17
14	2	10	9	6	17	6	8	47	2	16
15	2	19	9	6	23	7	8	49	3	15
16	2	28	10	6	30	7	8	52	3	14
17	2	38	9	6	37	6	8	55	2	13
18	2	47	9	6	43	7	8	57	2	12
19	2	56	8	6	50	6	8	59	2	11
20	3	4	9	6	56	6	9	1	2	10
21	3	13	9	7	2	6	9	3	1	9
22	3	22	9	7	8	6	9	4	2	8
23	3	31	8	7	14	6	9	6	1	7
24	3	39	9	7	20	6	9	7	1	6
25	3	48	9	7	26	5	9	8	1	5
26	3	57	8	7	31	6	9	9	1	4
27	4	5	8	7	37	5	9	10	1	3
28	4	13	9	7	42	5	9	11	0	2
29	4	22	8	7	47	5	9	11	1	1
30	4	30		7	52		9	12		0
	—			—			—			
S	11			10			9			

Annual Equation of Moon's Mean Node.

Argument. Sun's Mean Anomaly.

S	3 + ′	″	Diff. ″	4 + ′	″	Diff. ″	5 + ′	″	Diff. ″	S
0	9	12	0	8	4	5	4	42	9	30
1	9	12	0	7	59	5	4	33	8	29
2	9	12	0	7	54	5	4	25	9	28
3	9	12	1	7	49	5	4	16	9	27
4	9	11	0	7	44	6	4	7	9	26
5	9	11	1	7	38	5	3	58	9	25
6	9	10	1	7	33	6	3	49	9	24
7	9	9	1	7	27	6	3	40	9	23
8	9	8	1	7	21	6	3	31	9	22
9	9	7	1	7	15	6	3	22	9	21
10	9	6	2	7	9	6	3	13	9	20
11	9	4	2	7	3	6	3	4	10	19
12	9	2	2	6	57	7	2	54	9	18
13	9	0	2	6	50	6	2	45	9	17
14	8	58	2	6	44	7	2	36	10	16
15	8	56	2	6	37	7	2	26	9	15
16	8	54	3	6	30	7	2	17	10	14
17	8	51	2	6	23	7	2	7	10	13
18	8	49	3	6	16	7	1	57	9	12
19	8	46	3	6	9	8	1	48	10	11
20	8	43	3	6	1	7	1	38	10	10
21	8	40	4	5	54	8	1	28	9	9
22	8	36	3	5	46	7	1	19	10	8
23	8	33	4	5	39	8	1	9	10	7
24	8	29	4	5	31	8	0	59	10	6
25	8	25	4	5	23	8	0	49	10	5
26	8	21	4	5	15	8	0	39	9	4
27	8	17	4	5	7	9	0	30	10	3
28	8	13	5	4	58	8	0	20	10	2
29	8	8	4	4	50	8	0	10	10	1
30	8	4		4	42		0	0		0
	—			—			—			
S	8			7			6			S

Annual Equation of MOON's Mean Anomaly.

Argument. The Sun's Mean Anomaly.

S	0 + ′	″	Diff. ″	1 + ′	″	Diff. ″	2 + ′	″	Diff. ″	3 + ′	″	Diff. ″	4 + ′	″	Diff. ″	5 + ′	″	Diff. ″	S
0	0	0	22	10	37	19	18	33	12	21	42	0	19	1	11	11	5	20	30
1	0	22	22	10	56	19	18	45	11	21	42	0	18	50	12	10	45	20	29
2	0	44	22	11	15	19	18	56	10	21	42	1	18	38	12	10	25	21	28
3	1	6	23	11	34	19	19	6	11	21	41	0	18	26	12	10	4	21	27
4	1	29	22	11	53	18	19	17	10	21	41	2	18	14	13	9	43	20	26
5	1	51	22	12	11	19	19	27	10	21	39	1	18	1	13	9	23	21	25
6	2	13	22	12	30	18	19	37	9	21	38	2	17	48	13	9	2	22	24
7	2	35	22	12	48	18	19	46	9	21	36	3	17	35	14	8	40	21	23
8	2	57	22	13	6	17	19	55	9	21	33	2	17	21	14	8	19	22	22
9	3	19	21	13	23	18	20	4	9	21	31	4	17	7	14	7	57	21	21
10	3	40	22	13	41	17	20	13	8	21	27	3	16	53	15	7	36	22	20
11	4	2	22	13	58	17	20	21	7	21	24	4	16	38	15	7	14	22	19
12	4	24	22	14	15	16	20	28	8	21	20	5	16	23	15	6	52	22	18
13	4	46	21	14	31	17	20	36	7	21	15	5	16	8	15	6	30	23	17
14	5	7	22	14	48	16	20	43	6	21	10	5	15	53	16	6	7	22	16
15	5	29	21	15	4	16	20	49	6	21	5	5	15	37	17	5	45	22	15
16	5	50	21	15	20	16	20	55	6	21	0	6	15	20	16	5	23	23	14
17	6	11	22	15	36	15	21	1	5	20	54	7	15	4	17	5	0	23	13
18	6	33	21	15	51	15	21	6	5	20	47	6	14	47	17	4	37	23	12
19	6	54	21	16	6	15	21	11	5	20	41	7	14	30	17	4	14	22	11
20	7	15		16	21		21	16		20	34		14	13		3	52		10

Annual Equation of MOON's Mean Anomaly.

Argument. Sun's Mean Anomaly.

S	0		1		2		3		4		5		S
	+	Diff.	+	Diff.	+	Diff.	+	Diff.	+	Diff.	+	Diff.	
°	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	°
21	7 36	21	16 36	15	21 21	5	20 26	8	13 55	18	3 29	23	9
22	7 56	20	16 50	14	21 25	4	20 18	8	13 37	18	3 6	23	8
23	8 17	21	17 4	14	21 28	3	20 10	8	13 19	18	2 43	23	7
24	8 37	20	17 17	13	21 31	3	20 1	9	13 1	18	2 19	24	6
25	8 58	21	17 31	14	21 34	3	19 52	9	12 42	19	1 56	23	5
26	9 18	20	17 44	13	21 36	2	19 43	9	12 23	19	1 33	23	4
27	9 38	20	17 57	13	21 38	2	19 33	10	12 4	19	1 10	23	3
28	9 58	20	18 9	12	21 40	2	19 23	10	11 44	20	0 47	23	2
29	10 17	19	18 21	12	21 41	1	19 12	11	11 25	19	0 23	24	1
30	10 37	20	18 33	12	21 42	1	19 1	11	11 5	20	0 0	23	0
	—		—		—		—		—		—		
S	11		10		9		8		7		6		S

I For the MOON's Longitude.

Argument I. Sun's Mean Anomaly.

S	0		1		2		3		4		5		S
	+	Diff.	+	Diff.	+	Diff.	+	Diff.	+	Diff.	+	Diff.	
°	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	°
0	0 0,0	11,4	5 26,6	9,9	9 31,3	5,9	11 8,6	0,2	9 46,7	5,7	5 42,0	10,3	30
1	0 11,4	11,3	5 36,5	9,7	9 37,2	5,8	11 8,8	0,0	9 41,0	5,9	5 31,7	10,4	29
2	0 22,7	11,4	5 46,2	9,8	9 43,0	5,5	11 8,8	0,2	9 35,1	6,2	5 21,3	10,6	28
3	0 34,1	11,3	5 56,0	9,6	9 48,5	5,4	11 8,6	0,4	9 28,9	6,3	5 10,7	10,6	27
4	0 45,4	11,3	6 5,6	9,5	9 53,9	5,3	11 8,2	0,5	9 22,6	6,5	5 0,1	10,7	26
5	0 56,7	11,3	6 15,1	9,4	9 59,2	5,0	11 7,7	0,9	9 16,1	6,7	4 49,4	10,8	25
6	1 8,0	11,3	6 24,5	9,3	10 4,2	4,9	11 6,8	1,0	9 9,4	6,8	4 38,6	10,9	24
7	1 19,3	11,3	6 33,8	9,1	10 9,1	4,6	11 5,8	1,2	9 2,6	7,0	4 27,7	11,0	23
8	1 30,6	11,2	6 42,9	9,2	10 13,7	4,5	11 4,6	1,4	8 55,6	7,3	4 16,7	11,1	22
9	1 41,8	11,3	6 52,1	8,9	10 18,2	4,4	11 3,2	1,8	8 48,3	7,3	4 5,6	11,2	21
10	1 53,1	11,2	7 1,0	8,8	10 22,6	4,1	11 1,4	1,8	8 41,0	7,6	3 54,4	11,2	20
11	2 4,3	11,1	7 9,8	8,7	10 26,7	4,0	10 59,6	2,0	8 33,4	7,6	3 43,2	11,4	19
12	2 15,4	11,1	7 18,5	8,6	10 30,7	3,7	10 57,6	2,2	8 25,8	7,9	3 31,8	11,3	18
13	2 26,5	11,1	7 27,1	8,5	10 34,4	3,6	10 55,4	2,5	8 17,9	8,0	3 20,5	11,5	17
14	2 37,6	11,0	7 35,6	8,3	10 38,0	3,3	10 52,9	2,6	8 9,9	8,2	3 9,0	11,4	16
15	2 48,6	11,0	7 43,9	8,2	10 41,3	3,2	10 50,3	2,9	8 1,7	8,3	2 57,6	11,6	15
16	2 59,6	10,9	7 52,1	8,0	10 44,5	3,1	10 47,4	3,0	7 53,4	8,5	2 46,0	11,7	14
17	3 10,5	10,9	8 0,1	7,9	10 47,6	2,8	10 44,4	3,3	7 44,9	8,6	2 34,3	11,7	13
18	3 21,4	10,8	8 8,0	7,8	10 50,4	2,6	10 41,1	3,4	7 36,3	8,9	2 22,6	11,7	12
19	3 32,2	10,7	8 15,8	7,6	10 53,0	2,4	10 37,7	3,7	7 27,4	8,8	2 10,9	11,8	11
20	3 42,9	10,7	8 23,4	7,5	10 55,4	2,2	10 34,0	3,8	7 18,6	9,1	1 59,1	11,7	10
21	3 53,6	10,7	8 30,9	7,3	10 57,6	2,0	10 30,2	4,1	7 9,5	9,2	1 47,4	11,8	9
22	4 4,3	10,6	8 38,2	7,2	10 59,6	1,8	10 26,1	4,2	7 0,3	9,3	1 35,6	11,9	8
23	4 14,9	10,5	8 45,4	7,0	11 1,4	1,6	10 21,9	4,5	6 51,0	9,5	1 23,7	12,0	7
24	4 25,4	10,4	8 52,4	6,9	11 3,0	1,5	10 17,4	4,6	6 41,5	9,6	1 11,7	11,9	6
25	4 35,8	10,3	8 59,3	6,7	11 4,5	1,3	10 12,8	4,9	6 31,9	9,7	0 59,8	11,9	5
26	4 46,1	10,2	9 6,0	6,5	11 5,8	1,0	10 7,9	5,0	6 22,2	9,8	0 47,9	12,0	4
27	4 56,3	10,2	9 12,5	6,4	11 6,8	0,8	10 2,9	5,1	6 12,4	10,0	0 35,9	11,9	3
28	5 6,5	10,0	9 18,9	6,3	11 7,6	0,6	9 57,8	5,4	6 2,4	10,1	0 24,0	12,0	2
29	5 16,5	10,1	9 25,2	6,1	11 8,2	0,4	9 52,4	5,7	5 52,3	10,3	0 12,0	12,0	1
30	5 26,6		9 31,3		11 8,6		9 46,7		5 42,0		0 0,0		0
	—		—		—		—		—		—		
S	11		10		9		8		7		6		S

S	II. For the ☽'s Long. Argument II. 2 ☽ à ☉ + Arg. I.			III. For the ☽'s Long. Argument III. 2 ☽ à ☉ − Arg. I.						IV. For the ☽'s Long. Argument IV. 2 ☽ à ☉ + ☽'s Me. Ano.			S
S	0	1	2	0		1		2		0	1	2	S
	—	—	—	—		—		—		+	+	+	
S	6 +	7 +	8 +	6 +		7 +		8 +		6 —	7 —	8 —	S
°	″	″	″	′	″	′	″	′	″	″	″	″	°
0	0,0	28,0	8,4	0	0,0	0	37,8	1	5,2	0,0	28,9	50,1	30
1	1,0	28,8	48,9	0	1,3	0	38,8	1	5,9	1,0	29,8	50,6	29
2	2,0	29,6	49,4	0	2,6	0	39,9	1	6,5	2,0	30,6	51,0	28
3	2,9	30,4	49,8	0	3,9	0	41,0	1	7,1	3,0	31,5	51,5	27
4	3,9	31,3	50,3	0	5,3	0	42,1	1	7 7	4,0	32,3	52,0	26
5	4,8	32,1	50,7	0	6,6	0	43,2	1	8 3	5,0	33,2	52,4	25
6	5,8	32,9	51,1	0	7,9	0	44,3	1	8,8	6,0	34,0	52,8	24
7	6,8	33,6	51,5	0	9,2	0	45,3	1	9,3	7,0	34,8	53,2	23
8	7,8	34,4	51,8	0	10,5	0	46,4	1	9,8	8,0	35,6	53,6	22
9	8,7	35,2	52,2	0	11,8	0	47,4	1	10,2	9,0	36,4	54,0	21
10	9,7	35,9	52,5	0	13,1	0	48,4	1	10,8	10,0	37,2	54,3	20
11	10,7	36,7	52,9	0	14,4	0	49,4	1	11,2	11,0	37,9	54,7	19
12	11,6	37,4	53,2	0	15,7	0	50,4	1	11,6	12,0	38,7	55,0	18
13	12,6	38,1	53,5	0	16,9	0	51,4	1	12,0	13,0	39,4	55,3	17
14	13,5	38,8	53,7	0	18,2	0	52,3	1	12,4	14,0	40,2	55,6	16
15	14,5	39,5	54,0	0	19,5	0	53,3	1	12,7	15,0	40,9	55,8	15
16	15,4	40,2	54,3	0	20,8	0	54,2	1	13,1	15,9	41,6	56,1	14
17	16,3	40,9	54,5	0	22,0	0	55,1	1	13,4	16,9	42,3	56,3	13
18	17,3	41,5	54,7	0	23,3	0	56,0	1	13,7	17,9	43,0	56,5	12
19	18,2	42,2	54,9	0	24,5	0	56,8	1	13,9	18,8	43,6	56,7	11
20	19,1	42,8	55,0	0	25,8	0	57,7	1	14,2	19,8	44,3	56,9	10
21	20,0	43,4	55,2	0	27,0	0	58,5	1	14,4	20,7	44,9	57,1	9
22	20,9	44,0	55,4	0	28,2	0	59,3	1	14,6	21,6	45,5	57,2	8
23	21,8	44,6	55,5	0	29,4	1	0,1	1	14,7	22,6	46,2	57,4	7
24	22,7	45,2	55,6	0	30,6	1	0,9	1	14,9	23,5	46,8	57,5	6
25	23,6	45,8	55,7	0	31,8	1	1,7	1	15,0	24,4	47,4	57,6	5
26	24,5	46,4	55,8	0	33,0	1	2,4	1	15,1	25,3	47,9	57,7	4
27	25,4	46,9	55,8	0	34,2	1	3,2	1	15,2	26,2	48,5	57,7	3
28	26,2	47,4	55,9	0	35,4	1	3,9	1	15,3	27,1	49,0	57,8	2
29	27,1	47,9	55,9	0	36,5	1	4,6	1	15,3	28,0	49,6	57,8	1
30	28,0	48,4	55,9	0	37,7	1	5,2	1	15,3	28,9	50 1	57,8	0
	+	+	+	+		+		+		—	—	—	
S	11	10	9	11		10		9		11	10	9	S
	—	—	—	—		—		—		+	+	+	
S	5	4	3	5		4		3		5	4	3	S

V. For the Moon's Longitude. Evection.

Arg. V. 2 ☽ à ☉ — ☽'s Mean Anomaly.

S	0				1				2				S
	—			Dif.	—			Dif.	—			Dif.	
°	°	′	″	″	°	′	″	″	°	′	″	″	°
0	0	0	0,0	83,0	0	39	43,8	72,0	1	9	11,1	42,1	30
1	0	1	23,0	83,1	0	40	55,8	71,3	1	9	53,2	40,9	29
2	0	2	46,1	82,9	0	42	7,1	70,5	1	10	34,1	39,6	28
3	0	4	9,0	82,9	0	43	17,6	69,8	1	11	13,7	38,3	27
4	0	5	31,9	82,8	0	44	27,4	69,1	1	11	52,0	37,1	26
5	0	6	54,7	82,7	0	45	36,5	68,2	1	12	29,1	35,9	25
6	0	8	17,4	82,5	0	46	44,7	67,4	1	13	4,9	34,4	24
7	0	9	39,9	82,4	0	47	52,1	66,5	1	13	39,3	33,1	23
8	0	11	2,3	82,2	0	48	58,6	65,7	1	14	12,4	31,8	22
9	0	12	24,5	82,0	0	50	4,3	64,7	1	14	44,2	30,4	21
10	0	12	46,5	81,7	0	51	9,0	63,9	1	15	14,6	29,1	20
11	0	15	8,2	81,4	0	52	12,9	63,0	1	15	43,7	27,8	19
12	0	16	29,6	81,2	0	53	15,9	62,1	1	16	11,5	26,3	18
13	0	17	50,8	80,8	0	54	18,0	61,0	1	16	37,8	25,0	17
14	0	19	11,6	80,6	0	55	19,0	60,1	1	17	2,8	23,6	16
15	0	20	32,2	80,1	0	56	19,1	59,1	1	17	26,4	22,1	15

V. For the Moon's Longitude. Evection.

Arg. V. 2 ☽ à ☉ — ☽'s Mean Anomaly.

S	0				1				2				S
	—			Dif.	—			Dif.	—			Dif.	
°	°	′	″	″	°	′	″	″	°	′	″	″	°
16	0	21	52,2	79,8	0	57	18,2	58,1	1	17	48,5	20,7	14
17	0	23	12,1	79,4	0	58	16,3	57,0	1	18	9,2	19,4	13
18	0	24	31,5	78,9	0	59	13,3	55,9	1	18	28,6	18,0	12
19	0	25	50,4	78,4	1	0	9,2	55,0	1	18	46,6	16,4	11
20	0	27	8,8	78,0	1	1	4,3	53,9	1	19	3,0	15,1	10
21	0	28	26,8	77,5	1	1	58,1	52,6	1	19	18,1	13,6	9
22	0	29	44,3	77,0	1	2	50,7	51,[illegible]	1	19	31,7	12,2	8
23	0	31	1,3	76,5	1	3	42,4	50,5	1	19	43,9	10,7	7
24	0	32	17,8	75,9	1	4	32,9	49,3	1	19	54,6	9,3	6
25	0	33	33,7	75,2	1	5	22,2	48,1	1	20	3,9	7,8	5
26	0	34	48,9	74,7	1	6	10,3	47,0	1	20	11,7	6,4	4
27	0	36	3,6	74,1	1	6	57,3	45,8	1	20	18,1	4,9	3
28	0	37	17,7	73,3	1	7	43,1	44,6	1	20	23,0	3,5	2
29	0	38	31,0	72,8	1	8	27,7	43,4	1	20	26,5	1,9	1
30	0	39	43,8		1	9	11,1		1	20	28,4		0
	+				+				+				
S	11				10				9				S

V. For the Moon's Longitude. Evection.

Arg. V. 2 ☽ à ☉ — ☽'s Mean Anomaly.

S	3				4				5				S
	—			Dif.	—			Dif.	—			Dif.	
°	°	′	″	″	°	′	″	″	°	′	″	″	°
0	1	20	28,4	0,5	1	10	11,9	42,2	0	40	44,6	74,0	30
1	1	20	28,9	0,9	1	9	29,7	43,4	0	39	30,6	74,7	29
2	1	20	28,0	2,5	1	8	46,3	44,8	0	38	15,9	75,5	28
3	1	20	25,5	4,0	1	8	1,5	46,0	0	37	0,4	76,1	27
4	1	20	21,5	5,4	1	7	15,5	47,3	0	35	44,3	76,8	26
5	1	20	16,1	6,9	1	6	28,2	48,5	0	34	27,5	77,5	25
6	1	20	9,2	8,3	1	5	39,7	49,8	0	33	10,0	78,1	24
7	1	20	0,9	9,8	1	4	49,9	51,0	0	31	51,9	78,8	23
8	1	19	51,1	11,3	1	3	58,9	52,2	0	30	33,1	79,3	22
9	1	19	39,8	12,8	1	3	6,7	53,3	0	29	13,8	79,8	21
10	1	19	27,0	14,2	1	2	13,4	54,6	0	27	54,0	80,4	20
11	1	19	12,8	15,6	1	1	18,8	55,7	0	26	33,6	80,9	19
12	1	18	57,2	17,2	1	0	23,1	56,8	0	25	12,7	81,4	18
13	1	18	40,0	18,5	0	59	26,3	57,9	0	23	51,3	81,8	17
14	1	18	21,5	20,1	0	58	28,4	59,1	0	22	29,5	82,3	16
15	1	18	1,4	21,4	0	57	29,3	60,1	0	21	7,2	82,6	15
16	1	17	40,0	23,0	0	56	29,2	61,2	0	19	44,6	83,0	14
17	1	17	17,0	24,3	0	55	28,0	62,2	0	18	21,6	83,4	13
18	1	16	52,7	25,8	0	54	25,7	63,2	0	16	58,2	83,8	12
19	1	16	26,9	27,1	0	53	22,5	64,2	0	15	34,4	84,0	11
20	1	15	59,8	28,6	0	52	18,2	65,3	0	14	10,4	84,3	10
21	1	15	31,2	30,0	0	51	12,9	66,1	0	12	46,1	84,5	9
22	1	15	1,2	31,3	0	50	6,8	67,2	0	11	21,6	84,7	8
23	1	14	29,9	32,8	0	48	59,6	68,1	0	9	56,9	84,9	7
24	1	13	57,1	34,2	0	47	51,5	69 0	0	8	32,0	85,1	6
25	1	13	22,9	35,5	0	46	42,5	69,9	0	7	6,9	85,2	5
26	1	12	47,4	36,9	0	45	32,6	70,8	0	5	41,7	85,3	4
27	1	12	10,5	38,2	0	44	21,8	71,5	0	4	16,4	85,4	3
28	1	11	32,3	39,5	0	43	10,3	72,5	0	2	51,0	85,5	2
29	1	10	52,8	40,9	0	41	57,8	73,2	0	1	25,5	85,5	1
30	1	10	11,9		0	40	44,6		0	0	0,0		0
	+				+				+				
S	8				7				6				

VI. For the ☽'s Long. Argument VI. Arg. V + Arg. I.				VII. For ☽ Lo. Argu. VII. Arg. V − Arg. I			VIII. For ☽'s Lo. Argument VIII. ☽ M. An. − Ar. I.			
S	0 +	1 +	2 +	0 +	1 +	2 +	0 +	1 +	2 +	S
S	6 —	7 —	8 —	6 —	7 —	8 —	6 —	7 —	8 —	S
°	′ ″	′ ″	′ ″	″	″	″	″	″	″	°
0	0 0,0	1 1,8	1 47,0	0,0	23,3	40,3	0,0	21,0	36,4	30
1	0 2,2	1 3,6	1 48,0	0,8	24,0	40,7	0,7	21,6	36,7	29
2	0 4,3	1 5,4	1 49,0	1,6	24,7	41,1	1,5	22,3	37,1	28
3	0 6,5	1 7,3	1 50,0	2,4	25,3	41,4	2,2	22,9	37,4	27
4	0 8,6	1 9,1	1 51,0	3,3	26,0	41,8	2,9	23,5	37,8	26
5	0 10,8	1 10,8	1 51,9	4,1	26,7	42,2	3,7	24,1	38,1	25
6	0 12,9	1 12,6	1 52,8	4,9	27,3	42,5	4,4	24,7	38,4	24
7	0 15,1	1 14,3	1 53,7	5,7	28,0	42,8	5,1	25,3	38,7	23
8	0 17,2	1 16,0	1 54,5	6,5	28,6	43,1	5,9	25,9	38,9	22
9	0 19,3	1 17,7	1 55,3	7,3	29,3	43,4	6,6	26,4	39,2	21
10	0 21,5	1 19,4	1 56,1	8,1	29,9	43,7	7,3	27,0	39,5	20
11	0 23,6	1 21,0	1 56,8	8,9	30,5	44,0	8,0	27,6	39,7	19
12	0 25,7	1 22,6	1 57,5	9,7	31,1	44,2	8,7	28,1	39,9	18
13	0 27,8	1 24,2	1 58,1	10,5	31,7	44,5	9,5	28,7	40,2	17
14	0 29,9	1 25,8	1 58,7	11,3	32,3	44,7	10,2	29,2	40,4	16
15	0 32,0	1 27,3	1 59,3	12,0	32,9	44,9	10,9	29,7	40,6	15
16	0 34,1	1 28,8	1 59,8	12,8	33,5	45,1	11,6	30,2	40,8	14
17	0 36,1	1 30,3	2 0,3	13,6	34,0	45,3	12,3	30,7	40,9	13
18	0 38,2	1 31,8	2 0,8	14,4	34,6	45,5	13,0	31,2	41,1	12
19	0 40,2	1 33,2	2 1,2	15,1	35,1	45,7	13,7	31,7	41,2	11
20	0 42,2	1 34,6	2 1,6	15,9	35,6	45,8	14,4	32,2	41,4	10
21	0 44,3	1 36,0	2 2,0	16,7	36,2	45,9	15,1	32,6	41,5	9
22	0 46,3	1 37,3	2 2,3	17,4	36,7	46,1	15,7	33,1	41,6	8
23	0 48,3	1 38,6	2 2,6	18,2	37,1	46,2	16,4	33,5	41,7	7
24	0 50,2	1 39,9	2 2,8	18,9	37,6	46,3	17,1	34,0	41,8	6
25	0 52,2	1 41,2	2 3,0	19,7	38,1	46,3	17,8	34,4	41,8	5
26	0 54,1	1 42,4	2 3,2	20,4	38,6	46,4	18,4	34,8	41,9	4
27	0 56,1	1 43,6	2 3,3	21,1	39,0	46,4	19,1	35,2	41,9	3
28	0 58,0	1 44,7	2 3,4	21,8	39,4	46,5	19,7	35,6	42,0	2
29	0 59,9	1 45,9	2 3,5	22,6	39,9	46,5	20,4	36,0	42,0	1
30	1 1,8	1 47,0	2 3,5	23,3	40,3	46,5	21,0	36,4	42,0	0
S	— 11	— 10	— 9	— 11	— 10	— 9	— 11	— 10	— 9	S
S	+ 5	+ 4	+ 3	+ 5	+ 4	+ 3	+ 5	+ 4	+ 3	S

IX. For the Moon's Longitude.

Arg. IX. Mean Dist. ☽ à ☉ — ☽'s Mean Anomaly.

S	0 —	Diff.	1 —	Diff.	2 ∓	Diff.	S
°	′ ″	″	′ ″	″	′ ″	″	°
0	0 0,0	1,6	0 38,3	0,7	0 30,0	1,2	30
1	0 1,6	1,6	0 39,0	0,6	0 28,8	1,2	29
2	0 3,2	1,6	0 39,6	0,4	0 27,6	1,3	28
3	0 4,8	1,6	0 40,0	0,5	0 26,3	1,5	27
4	0 6,4	1,6	0 40,5	0,4	0 24,8	1,4	26
5	0 8,0	1,5	0 40,9	0,4	0 23,4	1,4	25
6	0 9,5	1,6	0 41,3	0,2	0 22,0	1,6	24
7	0 11,1	1,5	0 41,5	0,2	0 20,4	1,6	23
8	0 12,6	1,5	0 41,7	0,2	0 18,8	1,6	22
9	0 14,1	1,6	0 41,9	0,0	0 17,2	1,6	21
10	0 15,7	1,5	0 41,9	0,0	0 15,6	1,8	20
11	0 17,2	1,5	0 41,9	0,0	0 13,8	1,7	19
12	0 18,7	1,4	0 41,9	0,1	0 12,1	1,7	18
13	0 20,1	1,4	0 41,8	0,2	0 10,4	1,8	17
14	0 21,5	1,3	0 41,6	0,3	0 8,6	1,8	16
15	0 22,8		0 41,3		0 6,8		15
16	0 24,1	1,3	0 41,1	0,2	0 5,0	1,8	14
17	0 25,5	1,4	0 40,7	0,4	0 3,1	1,9	13
18	0 26,7	1,2	0 40,2	0,5	0 1,2	1,9	12
19	0 27,9	1,2	0 39,7	0,5	0 0,8	2,0	11
20	0 29,1	1,2	0 39,1	0,6	0 2,8	2,0	10
21	0 30,3	1,2	0 38,5	0,6	0 4,7	1,9	9
22	0 31,4	1,1	0 37,8	0,7	0 6,7	2,0	8
23	0 32,4	1,0	0 37,1	0,7	0 8,6	1,9	7
24	0 33,5	1,1	0 36,2	0,9	0 10,7	2,1	6
25	0 34,4	0,9	0 35,3	0,9	0 12,6	1,9	5
26	0 35,2	0,8	0 34,4	0,9	0 14,6	2,0	4
27	0 36,1	0,9	0 33,4	1,0	0 16,7	2,1	3
28	0 36,9	0,8	0 32,3	1,1	0 18,7	2,0	2
29	0 37,7	0,8	0 31,2	1,1	0 20,7	2,0	1
30	0 38,3	0,6	0 30,0	1,2	0 22,7	2,0	0
	+		+		±		
S	11		10		9		S

IX. For the Moon's Longitude.

Arg. IX. Mean Dist. ☽ à ☉ — ☽'s Mean Anomaly.

S	3 +	Diff.	4 +	Diff.	5 +	Diff.	S
°	′ ″	″	′ ″	″	′ ″	″	°
0	0 22,7	2,0	1 9,4	0,8	1 1,1	1,4	30
1	0 24,7	2,0	1 10,2	0,7	0 59,7	1,4	29
2	0 26,7	2,0	1 10,9	0,5	0 58,3	1,5	28
3	0 28,7	1,9	1 11,4	0,6	0 56,8	1,6	27
4	0 30,6	2,0	1 12,0	0,5	0 55,2	1,6	26
5	0 32,6	1,8	1 12,5	0,5	0 53,6	1,7	25
6	0 34,4	2,0	1 13,0	0,3	0 51,9	1,7	24
7	0 36,4	1,9	1 13,3	0,3	0 50,2	1,8	23
8	0 38,3	1,8	1 13,6	0,2	0 48,4	1,9	22
9	0 40,1	1,9	1 13,8	0,1	0 46,5	1,8	21
10	0 42,0	1,8	1 13,9	0,0	0 44,7	2,0	20
11	0 43,8	1,8	1 13,9	0,1	0 42,7	2,0	19
12	0 45,6	1,7	1 14,0	0,1	0 40,7	2,0	18
13	0 47,3	1,7	1 13,9	0,2	0 38,7	2,0	17
14	0 49,0	1,6	1 13,7	0,2	0 36,7	2,1	16
15	0 50,6	1,6	1 13,5	0,3	0 34,6	2,1	15
16	0 52,2	1,6	1 13,2	0,4	0 32,5	2,2	14
17	0 53,8	1,5	1 12,8	0,5	0 30,3	2,2	13
18	0 55,3	1,5	1 12,3	0,6	0 28,1	2,3	12
19	0 56,8	1,4	1 11,7	0,6	0 25,8	2,3	11
20	0 58,2	1,4	1 11,1	0,6	0 23,5	2,2	10
21	0 59,6	1,4	1 10,5	0,8	0 21,3	2,3	9
22	1 1,0	1,2	1 9,7	0,8	0 19,0	2,3	8
23	1 2,2	1,2	1 8,9	1,0	0 16,7	2,4	7
24	1 3,4	1,2	1 7,9	1,0	0 14,3	2,3	6
25	1 4,6	1,0	1 6,9	1,0	0 12,0	2,4	5
26	1 5,6	1,0	1 5,9	1,1	0 9,6	2,4	4
27	1 6,6	1,0	1 4,8	1,2	0 7,2	2,4	3
28	1 7,6	1,0	1 3,6	1,2	0 4,8	2,4	2
29	1 8,6	0,8	1 2,4	1,3	0 2,4	2,4	1
30	1 9,4		1 1,1		0 0,0		0
	—		—		—		
S	8		7		6		S

X. For the ☽'s Long.			XI. For ☽ Lo.			XII. For ☽ Lon.			
Argument X. M.Lo.☊—TrueLon.			Argum. XI. ☽ à ☉ + ☉ An.			Argument X[illegible] ☽ à ☉ — ☉ Ano.			
S	0 +	1 +	2 +	0 —	1 —	2 —	0 —	1 —	2 —	S
S	6 —	7 +	8 +	6 +	7 +	8 +	6 +	7 +	8 +	S
°	′ ″	′ ″	′ ″	″	″	″	″	″	″	°
0	0 0,0	0 52,3	0 52,3	0,0	8,5	14,7	0,0	1,6	2,7	30
1	0 2,1	0 53,3	0 51,2	0,3	8,8	14,9	0,1	1,6	2,7	29
2	0 4,2	0 54,3	0 50,[illegible]	0,6	9,0	15,0	0,2	1,6	2,7	28
3	0 6,3	0 55,2	0 48,9	0,9	9,3	15,2	0,2	1,7	2,8	27
4	0 8,4	0 56,0	0 47,6	1,2	9,5	15,3	0,3	1,7	2,8	26
5	0 10,5	0 56,8	0 46,3	1,5	9,8	15,4	0,3	1,8	2,8	25
6	0 12,6	0 57,4	0 44,9	1,8	10,0	15,5	0,4	1,8	2,8	24
7	0 14,6	0 58,0	0 43,5	2,1	10,2	15,6	0,4	1,9	2,9	23
8	0 16,7	0 58,6	0 42,0	2,4	10,5	15,8	0,5	1,9	2,9	22
9	0 18,7	0 59,1	0 40,4	2,7	10,7	15,9	0,5	2,0	2,9	21
10	0 20,7	0 59,5	0 38,8	3,0	10,9	16,0	0,6	2,0	2,9	20
11	0 22,6	0 59,8	0 37,2	3,3	11,2	16,1	0,7	2,0	2,9	19
12	0 24,6	1 0,1	0 35,5	3,5	11,4	16,2	0,7	2,1	3,0	18
13	0 26,5	1 0,[illegible]	0 33,8	3,8	11,6	16,3	0,8	2,1	3,0	17
14	0 28,4	1 0,4	0 32,0	4,1	11,8	16,3	0,8	2,2	3,0	16
15	0 30,2	1 0,4	0 30,2	4,4	12,0	16,4	0,9	2,2	3,0	15
16	0 32,0	1 0,4	0 28,4	4,7	12,2	16,5	0,9	2,2	3,0	14
17	0 33,8	1 0,3	0 26,5	5,0	12,4	16,6	0,9	2,3	3,0	13
18	0 35,5	1 0,1	0 24,6	5,3	12,6	16,6	1,0	2,3	3,0	12
19	0 37,2	0 59,8	0 22,6	5,5	12,8	16,7	1,0	2,3	3,0	11
20	0 38,8	0 59,5	0 20,7	5,8	13,0	16,7	1,1	2,4	3,1	10
21	0 40,4	0 59,1	0 18,7	6,1	13,2	16,8	1,1	2,4	3,1	9
22	0 42,0	0 58,6	0 16,7	6,4	13,4	16,8	1,2	2,4	3,1	8
23	0 43,5	0 58,0	0 14,6	6,6	13,6	16,9	1,2	2,5	3,1	7
24	0 44,9	0 57,4	0 12,[illegible]	6,9	13,8	16,9	1,3	2,5	3,1	6
25	0 46,3	0 56,8	0 10,[illegible]	7,2	13,9	16,9	1,3	2,5	3,1	5
26	0 47,6	0 56,[illegible]	0 8,4	7,5	14,1	17,0	1,4	2,6	3,1	4
27	0 48,9	0 55,2	0 6,[illegible]	7,7	14,3	17,0	1,4	2,6	3,1	3
28	0 50,[illegible]	0 54,3	0 4,2	8,	14,4	17,0	1,5	2,6	3,1	2
29	0 51,2	0 53,3	0 2,1	8,2	14,6	17,0	1,5	2,7	3,1	1
30	0 52,3	0 52,[illegible]	0 0,0	8,5	14,7	17,0	1,6	2,7	3,1	0
S	— 11	— 10	— 9	+ 11	+ 10	+ 9	+ 11	+ 10	+ 9	S
S	— 5	— 4	— 3	— 5	— 4	— 3	— 5	— 4	— 3	S

XIII. For the ☽'s Long.			XIV. For ☽ Lo[illegible]			XV. For ☽'s Lon[illegible]			
Argument XIII. 2 ☽ à ☉ + 2 ☽'s M. Ano.			Arg. XIV. 4 ☽ à ☉ -- ☽ M.A			Arg. XV. 2 ☽ à ☊ -- 2 ☽'s M.A			
S	0 —	1 —	2 —	0 +	1 +	2 +	0 —	1 —	2 —	S
S	6 +	7 +	8 +	6 —	7 —	8 —	6 +	7 +	8 +	S
°	″	″	″	″	″	″	″	″	″	°
0	0,0	1,9	3,2	0,0	6,2	10,7	0,0	3,2	5,5	30
1	0,1	1,9	3,2	0,2	6,4	10,8	0,1	3,2	5,5	29
2	0,1	2,0	3,3	0,4	6,6	11,0	0,2	3,3	5,6	28
3	0,2	2,0	3,3	0,6	6,8	11,1	0,3	3,4	5,6	27
4	0,3	2,1	3,3	0,9	6,9	11,2	0,4	3,5	5,7	26
5	0,3	2,1	3,4	1,1	7,1	11,2	0,6	3,6	5,7	25
6	0,4	2,2	3,4	1,3	7,3	11,3	0,7	3,7	5,8	24
7	0,5	2,2	3,4	1,5	7,5	11,4	0,8	3,8	5,8	23
8	0,5	2,3	3,4	1,7	7,6	11,5	0,9	3,9	5,8	22
9	0,6	2,3	3,5	1,9	7,8	11,6	1,0	4,0	5,9	21
10	0,6	2,4	3,5	2,2	8,0	11,7	1,1	4,1	5,9	20
11	0,7	2,4	3,5	2,4	8,1	11,7	1,2	4,1	6,0	19
12	0,8	2,5	3,5	2,6	8,3	11,8	1,3	4,2	6,0	18
13	0,8	2,5	3,5	2,8	8,5	11,9	1,4	4,3	6,0	17
14	0,9	2,6	3,6	3,0	8,6	11,9	1,5	4,4	6,[illegible]	16
15	1,0	2,6	3,6	2,2	8,[illegible]	12,0	1,6	[illegible],5	6,[illegible]	15
16	1,0	2,7	3,6	[illegible],4	8,9	12,[illegible]	1,7	4,[illegible]	6,[illegible]	1[illegible]
17	1,1	2,7	3,6	3,6	9,1	12,[illegible]	1,8	4,[illegible]	6,[illegible]	13

XIII. For the ☽'s Long.			XIV. For ☽'s Lon.			XV. For the ☽'s Lon.			
Argument XIII. 2 ☽ à ☉ + 2 ☽'s M. Ano.			Argument XIV. 4 ☽ à ☉ — ☽'s M.A.			Argument XV. 2 ☽ à ☊ — 2 ☽'s M. A.			
S	0 —	1 —	2 —	0 +	1 +	2 +	0 —	1 —	2 —	S
S	6 +	7 +	8 +	6 —	7 —	8 —	6 +	7 +	8 +	S
°	″	″	″	″	″	″	″	″	″	°
18	1,1	2,8	3,6	3,8	9,2	12,1	2,0	4,7	6,2	12
19	1,2	2,8	3,6	4,0	9,4	12,2	2,1	4,[illegible]	6,2	11
20	1,3	2,8	3,6	4,2	9,5	12,2	2,2	4,8	6,2	10
21	1,3	2,9	3,7	4,5	9,6	12,2	2,3	4,9	6,2	9
22	1,4	2,9	3,7	4,7	9,8	12,3	2,4	5,0	6,2	8
23	1,4	3,0	3,7	4,9	9,9	12,3	2,5	5,0	6,3	7
24	1,5	3,0	3,7	5,0	10,0	12,3	2,6	5,1	6,3	6
25	1,6	3,0	3,7	5,2	10,2	12,3	2,7	5,2	6,3	5
26	1,6	3,1	3,7	5,4	10,3	12,4	2,8	5,2	6,3	4
27	1,7	3,1	3,7	5,6	10,3	12,4	2,9	5,3	6,3	3
28	1,7	3,1	3,7	5,8	10,5	12,4	3,0	5,3	6,3	2
29	1,8	3,2	3,7	6,0	10,6	12,4	[illegible],1	5,4	6,3	1
30	1,9	[illegible],2	3,7	6,2	10,7	12,4	[illegible],2	5,5	6,[illegible]	0
S	+ 11	+ 10	+ 9	— 11	— 10	— 9	+ 11	+ 10	+ 9	S
S	— 5	— 4	— 3	+ 5	+ 4	+ 3	— 5	— 4	— 3	S

XVI. For the ☽'s Long.			XVII. For ☽'s Lon.			XVIII. For ☽'s Long.			
Argument XVI. 2 ☽ à ☉ − 2 ☽ à ☊ + ☽ M.A.			Argument XVII. 2 ☽ á ☉ — 2 ☽ á ☊ — ☽'s M. A.			Argument XVIII. Mean Long. ☽'s ☊			
S	0 +	1 +	2 +	0 —	1 —	2 —	0 +	1 +	2 +	S
S	6 —	7 —	8 —	6 +	7 +	8 +	6 —	7 —	8 —	S
°	″	″	″	″	″	″	″	″	″	°
0	0,0	4,2	7,2	0,0	2,7	4,6	0,0	3,9	6,7	30
1	0,2	4,3	7,3	0,1	2,7	4,6	0,1	4,0	6,7	29
2	0,3	4,4	7,3	0,2	2,8	4,7	0,3	4,1	6,8	28
3	0,4	4,5	7,4	0,3	2,9	4,7	0,4	4,2	6,[illegible]	27
4	0,6	4,7	7,5	0,4	3,0	4,8	0,5	4,3	6,9	26
5	0,7	7,8	7,5	0,5	3,1	4,8	0,7	4,4	7,0	25
6	0,9	4,9	7,6	0,6	3,1	4,9	0,8	4,5	7,0	24
7	1,0	5,0	7,7	0,7	3,2	4,9	1,0	4,6	7,1	23
8	1,2	5,1	7,7	0,7	3,3	4,9	1,1	4,7	7,1	22
9	1,3	5,2	7,8	0,8	3,3	5,0	1,2	4,8	7,2	21
10	1,4	5,3	7,8	0,9	3,4	5,0	1,3	5,0	7,2	20
11	1,6	5,5	7,9	1,0	3,5	5,0	1,5	5,1	7,3	19
12	1,7	5,6	7,9	1,1	3,6	5,0	1,6	5,2	7,3	18
13	1,9	5,7	8,0	1,2	3,6	5,1	1,7	5,3	7,4	17
14	2,0	5,8	8,0	1,3	3,7	5,1	1,9	5,4	7,4	16
15	2,2	5,9	8,0	1,4	3,8	5,1	2,0	5,4	7,4	15
16	2,3	6,0	8,1	1,5	3,8	5,2	2,1	5,5	7,5	14
17	2,4	6,1	8,1	1,6	3,9	5,2	2,2	5,6	7,5	13
18	2,6	6,2	8,1	1,6	3,9	5,2	2,4	5,7	7,5	12
19	2,7	6,3	8,2	1,7	4,0	5,2	2,5	5,8	7,5	11
20	2,8	6,4	8,2	1,8	4,1	5,2	2,6	5,9	7,6	10
21	3,0	6,5	8,2	1,9	4,1	5,2	2,8	6,0	7,6	9
22	3,1	6,6	8,2	2,0	4,2	5,3	2,9	6,1	7,6	8
23	3,3	6,6	8,2	2,1	4,2	5,3	3,0	6,1	7,6	7
24	3,4	6,7	8,3	2,2	4,3	5,3	3,1	6,2	7,7	6
25	3,5	6,8	8,3	2,2	4,3	5,3	3,3	6,3	7,7	5
26	3,6	6,9	8,3	2,3	4,4	5,3	3,4	6,4	7,7	4
27	3,8	7,0	8,3	2,4	4,5	5,3	3,5	6,5	7,7	3
28	3,9	7,0	8,3	2,5	4,5	5,3	3,6	6,5	7,7	2
29	4,0	7,1	8,3	2,6	4,5	5,3	3,7	6,6	7,7	1
30	4,2	7,2	8,3	2,7	4,6	5,3	3,9	6,7	7,7	0
S	+ 5	+ 4	+ 3	— 5	— 4	— 3	+ 5	+ 4	+ 3	S
S	— 11	— 10	— 9	+	+	+	— [illegible]	— [illegible]	— [illegible]	S

XIX. For the MOON's Longitude. Equation Center.

Argument XIX. Moon's Correct Anomaly.

S	0 — ° ′ ″	Diff. ′ ″	1 — ° ′ ″	Diff. ′ ″	2 — ° ′ ″	Diff. ′ ″	S
0	0 0 0,0	6 10,9	2 58 30,5	5 28,1	5 16 20,9	3 27,1	30
1	0 6 10,9	6 10,7	3 3 58,6	5 25,2	5 19 48,0	3 21,9	29
2	0 12 21,6	6 10,6	3 9 23,8	5 22,4	5 23 9,9	3 16,6	28
3	0 18 32,2	6 10,3	3 14 46,2	5 19,2	5 26 26,5	3 11,2	27
4	0 24 42,5	6 9,9	3 20 5,4	5 16,3	5 29 37,7	3 5,6	26
5	0 30 52,4	6 9,4	3 25 21,7	5 13,1	5 32 43,3	3 0,2	25
6	0 37 1,8	6 8,9	3 30 34,8	5 9,9	5 35 43,5	2 54,7	24
7	0 43 10,7	6 8,3	3 35 44,7	5 6,5	5 38 38,2	2 49,1	23
8	0 49 19,0	6 7,5	3 40 51,2	5 3,1	5 41 27,3	2 43,3	22
9	0 55 26,5	6 6,7	3 45 54,3	4 59,5	5 44 10,6	2 37,5	21
10	1 1 33,2	6 5,8	3 50 53,8	4 55,9	5 46 48,1	2 31,7	20
11	1 7 39,0	6 4,8	3 55 49,7	4 52,3	5 49 19,8	2 25,7	19
12	1 13 43,8	6 3,5	4 0 42,0	4 48,5	5 51 45,5	2 19,8	18
13	1 19 47,3	6 2,4	4 5 30,5	4 44,7	5 54 5,3	2 13,9	17
14	1 25 49,7	6 1,2	4 10 15,2	4 40,7	5 56 19,2	2 7,7	16
15	1 31 50,9	5 59,7	4 14 55,9	4 36,7	5 58 26,9	2 1,6	15
16	1 37 50,6	5 58,1	4 19 32,6	4 32,7	6 0 28,5	1 55,4	14
17	1 43 48,7	5 56,8	4 24 5,3	4 28,4	6 2 23,9	1 49,1	13
18	1 49 45,5	5 55,1	4 28 33,7	4 24,1	6 4 13,0	1 42,8	12
19	1 55 40,6	5 53,2	4 32 57,8	4 19,9	6 5 55,8	1 36,5	11
20	2 1 33,8	5 51,4	4 37 17,7	4 15,5	6 7 32,3	1 30,1	10
21	2 7 25,2	5 49,6	4 41 33,2	4 11,0	6 9 2,4	1 23,7	9
22	2 13 14,8	5 47,5	4 45 44,2	4 6,4	6 10 26,1	1 17,2	8
23	2 19 2,3	5 45,3	4 49 50,6	4 1,7	6 11 43,3	1 10,7	7
24	2 24 47,6	5 43,2	4 53 52,3	3 57,0	6 12 54,0	1 4,0	6
25	2 30 30,8	5 40,9	4 57 49,3	3 52,2	6 13 58,0	0 57,4	5
26	2 36 11,7	5 38,5	5 1 41,5	3 47,4	6 14 55,4	0 50,7	4
27	2 41 50,2	5 36,0	5 5 28,9	3 42,4	6 15 46,1	0 44,0	3
28	2 47 26,2	5 33,4	5 9 11,3	3 37,3	6 16 30,1	0 37,3	2
29	2 52 59,6	5 30,9	5 12 48,6	3 32,3	6 17 7,4	0 30,6	1
30	2 58 30,5		5 16 20,9		6 17 38,0		0
	+		+		+		
S	11		10		9		S

XIX. For the MOON's Longitude. Equation Center.

Argument XIX. Moon's Correct Anomaly.

S	3 — ° ′ ″	Diff. ′ ″	4 — ° ′ ″	Diff. ′ ″	5 — ° ′ ″	Diff. ′ ″	S
0	6 17 38,0	0 23,6	5 38 46,5	3 5,9	3 20 56,1	5 58,7	30
1	6 18 1,6	0 16,9	5 35 40,6	3 12,7	3 14 57,4	6 3,0	29
2	6 18 18,5	0 10,0	5 32 27,9	3 19,4	3 8 54,4	6 7,2	28
3	6 18 28,5	0 3,1	5 29 8,5	3 26,2	3 2 47,2	6 11,1	27
4	6 18 31,6	0 3,8	5 25 42,3	3 32,7	2 56 36,1	6 14,9	26
5	6 18 27,8	0 10,8	5 22 9,6	3 39,5	2 50 21,2	6 18,8	25
6	6 18 17,0	0 17,7	5 18 30,1	3 45,9	2 44 2,4	6 22,3	24
7	6 17 59,3	0 24,8	5 14 44,2	3 52,4	2 37 40,1	6 25,9	23
8	6 17 34,5	0 31,9	5 10 51,8	3 58,8	2 31 14,2	6 29,2	22
9	6 17 2,6	0 38,9	5 6 52,0	4 5,1	2 24 45,0	6 32,4	21
10	6 16 23,7	0 45,9	5 2 47,9	4 11,3	2 18 12,6	6 35,4	20
11	6 15 37,8	0 52,8	4 58 36,6	4 17,5	2 11 37,2	6 38,3	19
12	6 14 45,0	0 59,9	4 54 19,1	4 23,8	2 4 58,9	6 41,2	18
13	6 13 45,1	1 7,2	4 49 55,3	4 29,9	1 58 17,7	6 43,7	17
14	6 12 37,9	1 14,0	4 45 25,4	4 35,7	1 51 34,0	6 46,3	16
15	6 11 23,9	1 21,3	4 40 49,7	4 41,7	1 44 47,7	6 48,6	15
16	6 10 2,6	1 28,3	4 36 8,0	4 47,5	1 37 59,1	6 50,6	14
17	6 8 34,2	1 35,4	4 31 20,5	4 53,1	1 31 8,5	6 52,7	13
18	6 6 58,9	1 42,5	4 26 27,4	4 58,8	1 24 15,8	6 54,8	12
19	6 5 16,4	1 49,5	4 21 28,6	5 4,6	1 17 21,0	6 56,4	11
20	6 3 26,9	1 56,5	4 16 24,0	5 9,9	1 10 24,6	6 57,9	10

XIX. For the MOON's Longitude. Equation Center.

Argument XIX. Moon's Correct Anomaly.

S	3 — ° ′ ″	Diff. ′ ″	4 — ° ′ ″	Diff. ′ ″	5 — ° ′ ″	Diff. ′ ″	S
21	6 1 30,4	2 3,7	4 11 14,1	5 15,3	1 3 26,7	6 59,4	9
22	5 59 26,7	2 10,7	4 5 58,8	5 20,5	0 56 27,3	7 0,6	8
23	5 57 16,0	2 17,7	4 0 38,3	5 25,7	0 49 26,7	7 1,8	7
24	5 54 58,3	2 24,6	3 55 12,6	5 30,6	0 42 24,9	7 2,7	6
25	5 52 33,7	2 31,6	3 49 42,0	5 35,8	0 35 22,2	7 3,5	5
26	5 50 2,1	2 38,6	3 44 6,2	5 40,4	0 28 18,7	7 4,1	4
27	5 47 23,5	2 45,4	3 38 25,8	5 45,4	0 21 14,6	7 4,6	3
28	5 44 38,1	2 52,3	3 32 40,4	5 49,8	0 14 10,0	7 4,9	2
29	5 41 45,8	2 59,3	3 26 50,6	5 54,5	0 7 5,1	7 5,1	1
30	5 38 46,5		3 20 56,1		0 0 0,0		0
			+		+		
S	8		7		6		S

XX. For the MOON's Longitude. Variation.

Argument XX. ☽'s Equated Long. — ☉'s true Long.

S	0 + ′ ″	Diff. ″	1 + ′ ″	Diff. ″	2 ∓ ′ ″	Diff. ″	S
0	0 0,0	73,6	30 8,7	34,3	29 6,1	40,0	30
1	1 13,6	73,4	30 43,0	31,8	28 26,1	42,2	29
2	2 27,0	73,3	31 14,8	29,4	27 43,9	44,3	28
3	3 40,3	73,0	31 44,2	27,1	26 59,6	46,4	27
4	4 53,3	72,7	32 11,3	24,5	26 13,2	48,3	26
5	6 6,0	72,1	32 35,8	22,3	25 24,9	50,2	25
6	7 18,1	71,6	32 58,1	19,6	24 34,7	52,0	24
7	8 29,7	71,0	33 17,7	17,0	23 42,7	53,9	23
8	9 40,7	70,2	33 34,7	14,6	22 48,8	55,7	22
9	10 50,9	69,3	33 49,3	12,0	21 53,1	57,2	21
10	12 0,2	68,5	34 1,3	9,5	20 55,9	58,9	20
11	13 8,7	67,5	34 10,8	6,8	19 57,0	60,4	19
12	14 16,2	66,4	34 17,6	4,2	18 56,6	61,8	18
13	15 22,6	65,1	34 21,8	1,7	17 54,8	63,2	17
14	16 27,7	63,8	34 23,5	0,9	16 51,6	64,5	16
15	17 31,5	62,7	34 22,6	3,5	15 47,1	65,7	15
16	18 34,2	61,2	34 19,1	6,1	14 41,4	66,9	14
17	19 35,4	59,6	34 13,0	8,7	13 34,5	68,1	13
18	20 35,0	58,2	34 4,3	11,4	12 26,4	69,0	12
19	21 33,2	56,4	33 52,9	13,7	11 17,4	69,6	11
20	22 29,6	54,7	33 39,2	16,4	10 7,8	70,8	10
21	23 24,3	52,9	33 22,8	18,8	8 57,0	71,5	9
22	24 17,2	51,2	33 4,0	21,4	7 45,5	71,9	8
23	25 8,4	49,0	32 42,6	23,9	6 33,6	72,7	7
24	25 57,4	47,2	32 18,7	26,1	5 20,9	73,0	6
25	26 44,6	45,2	31 52,6	28,7	4 7,9	73,5	5
26	27 29,8	42,9	31 23,9	31,0	2 54,4	73,7	4
27	28 12,7	41,1	30 52,9	33,4	1 40,7	74,0	3
28	28 53,8	38,6	30 19,5	35,5	0 26,7	74,2	2
29	29 32,4	36,3	29 44,0	37,9	0 47,5	74,1	1
30	30 8,7		29 6,1		2 1,6		0
	—		—		∓		
S	11		10		9		S

XX. For the Moon's Longitude. Variation.

Arg. XX. ☽'s Equated Lon. — ☉'s True Lo.

S	3	Diff.	4	Diff.	5	Diff.	S
	—		—		—		
°	′ ″	″	′ ″	″	′ ″	″	°
0	2 1,6	74,1	32 27,7	35,3	31 54,7	39,9	30
1	3 15,7	74,0	33 3,0	32,9	31 14,8	42,2	29
2	4 29,7	73,6	33 35,9	30,6	30 32,6	44,3	28
3	5 43,3	73,5	34 6,5	28,2	29 48,3	46,7	27
4	6 56,8	73,1	34 34,7	25,9	29 1,6	48,6	26
5	8 9,9	72,6	35 0,6	23,3	28 13,0	50,8	25
6	9 22,5	71,9	35 23,9	20,9	27 22,2	52,7	24
7	10 34,4	71,3	35 44,8	18,4	26 29,5	54,7	23
8	11 45,7	70,5	36 3,2	15,8	25 34,8	56,3	22
9	12 56,2	69,8	36 19,0	13,4	24 38,5	58,3	21
10	14 6,0	68,8	36 32,4	10,7	23 40,2	60,0	20
11	15 14,8	67,8	36 43,1	8,0	22 40,2	61,6	19
12	16 22,6	66,7	36 51,1	5,5	21 38,6	63,2	18
13	17 29,3	65,7	36 56,6	2,9	20 35,4	64,9	17
14	18 35,0	64,3	36 59,5	0,3	19 30,5	66,0	16
15	19 39,3	63,1	36 59,8	2,3	18 24,5	67,4	15
16	20 42,4	61,6	36 57,5	4,9	17 17,1	68,7	14
17	21 44,0	60,2	36 52,6	7,6	16 8,4	70,0	13
18	22 44,2	58,6	36 45,0	10,2	14 58,4	70,9	12
19	23 42,8	57,1	36 34,8	12,9	13 47,5	71,9	11
20	24 39,9	55,4	36 21,9	15,4	12 35,6	72,9	10
21	25 35,3	53,5	36 6,5	18,0	11 22,7	73,8	9
22	26 28,8	51,9	35 48,5	20,4	10 8,9	74,6	8
23	27 20,7	49,8	35 28,1	23,2	8 54,3	75,0	7
24	28 10,5	48,2	35 4,9	25,5	7 39,3	75,7	6
25	28 58,7	45,9	34 39,4	28,1	6 23,6	76,2	5
26	29 44,6	44,0	34 11,3	30,5	5 7,4	76,5	4
27	30 28,6	41,9	33 40,8	33,0	3 50,9	76,8	3
28	31 10,5	39,8	33 7,8	35,4	2 34,1	77,0	2
29	31 50,3	37,4	32 32,4	37,7	1 17,1	77,1	1
30	32 27,7		31 54,7		0 0,0		0
	+		+		+		
	8		7		6		S

XXI. For the ☽'s Lon.

Argument XXI.
2 Eq. Di. ☽ à ☊ — ☽'s C.A.

S	0	1	2
	+	+	+
S	6 —	7 —	8 —
°	′ ″	′ ″	′ ″
0	0 0,0	0 42,1	1 12,[illegible]
1	0 1,5	0 43,3	1 13,6
2	0 2,9	0 44,6	1 14,[illegible]
3	0 4,4	0 45,[illegible]	1 14,9
4	0 5,9	0 47,0	1 15,6
5	0 7,3	0 48,2	1 16,2
6	0 8,8	0 49,4	1 16,[illegible]
7	0 10,3	0 50,6	1 17,4
8	0 11,7	0 51,8	1 18,0
9	0 13,2	0 53,0	1 18,5
10	0 14,6	0 54,1	1 19,0
11	0 16,1	0 55,2	1 19,5
12	0 17,5	0 56,[illegible]	1 20,0
13	0 18,9	0 57,4	1 20,4
14	0 20,4	0 58,4	1 20,8
15	0 21,8	0 59,5	1 21,2
16	0 23,2	1 0,5	1 21,6
17	0 24,6	1 1,5	1 22,0
18	0 26,0	1 2,5	1 22,3
19	0 27,4	1 3,5	1 22,[illegible]
20	0 28,8	1 4,4	1 22,9
21	0 30,1	1 5,4	1 23,1
22	0 31,5	1 6,[illegible]	1 23,[illegible]
23	0 32,9	1 7,2	1 2[illegible],5
24	0 34,2	1 8,1	1 23,7
25	0 35,5	1 8,9	1 23,8
26	0 36,9	1 9,7	1 23,9
27	0 38,2	1 10,[illegible]	1 24,0
28	0 39,5	1 11,[illegible]	1 24,1
29	0 40,8	1 12,1	1 24,1
30	0 42,1	1 12,8	1 24,1
	+	—	—
S	11	10	9
	—	+	+
S	5	4	3

XXII. For the ☽'s Long. Reduct.

Argument XXII.
Long. ☽ in Orbit. — Correct Long. ☊

S	0		1		2		S
	—		—		—		
S	6 —	Dif.	7 —	Dif.	8 —	Dif.	S
°	′ ″	″	′ ″	″	′ ″	″	°
0	0 0,0	14,2	5 53,1	6,9	5 53,1	7,3	30
1	0 14,2	14,2	6 0,0	6,4	5 45,8	7,8	29
2	0 28,4	14,2	6 6,4	6,0	5 38,0	8,2	28
3	0 42,6	14,1	6 12,4	5,6	5 29,8	8,5	27
4	0 56,7	14,1	6 18,0	5,1	5 21,3	9,0	26
5	1 10,8	14,0	6 23,1	4,7	5 12,3	9,3	25
6	1 24,8	13,8	6 27,8	4,1	5 3,0	9,7	24
7	1 38,6	13,8	6 31,9	3,7	4 53,3	10,1	23
8	1 52,4	13,6	6 35,6	3,2	4 43,2	10,4	22
9	2 6,0	13,4	6 38,8	2,7	4 32,8	10,7	21
10	2 19,4	13,3	6 41,5	2,2	4 22,1	11,1	20
11	2 32,7	13,1	6 43,7	1,8	4 11,0	11,4	19
12	2 45,8	12,9	6 45,5	1,2	3 59,6	11,6	18
13	2 58,7	12,7	8 46,7	0,7	3 48,0	11,9	17
14	3 11,4	12,5	6 47,4	0,3	3 36,1	12,2	16
15	3 23,9	12,2	6 47,7	0,3	3 23,9	12,5	15
16	3 36,1	11,9	6 47,4	0,7	3 11,4	12,7	14
17	3 48,0	11,6	6 46,7	1,2	2 58,7	12,9	13
18	3 59,6	11,4	6 45,5	1,8	2 45,8	13,1	12
19	4 11,0	11,1	6 43,7	2,2	2 32,7	13,3	11
20	4 22,1	10,7	6 41,5	2,7	2 19,4	13,4	10
21	4 32,8	10,4	6 38,8	3,2	2 6,0	13,6	9
22	4 43,2	10,1	6 35,6	3,7	1 52,4	13,8	8
23	4 53,3	9,7	6 31,9	4,1	1 38,6	13,8	7
24	5 3,0	9,3	6 27,8	4,7	1 24,8	14,0	6
25	5 12,3	9,0	6 23,1	5,1	1 10,8	14,1	5
26	5 21,3	8,5	6 18,0	5,6	0 56,7	14,1	4
27	5 29,8	8,2	6 12,4	6,0	0 42,6	14,2	3
28	5 38,0	7,8	6 6,4	6,4	0 28,4	14,2	2
29	5 45,8	7,3	6 0,0	6,9	0 14,2	14,2	1
30	5 53,1		5 53,1		0 0,0		0
	+		+		+		
	11		10		9		S
	+		+		+		
	5		4		3		S

Equation of the Equinoctial Points

Argument.
Mean Longitude Moon's Node.

S	0	1	2	S
	—	—	—	
S	6 +	7 +	8 +	S
°	″	″	″	°
0	0,0	9,0	15,6	30
1	0,3	9,3	15,8	29
2	0,6	9,5	15,9	28
3	0,9	9,8	16,0	27
4	1,2	10,0	16,2	26
5	1,5	10,3	16,3	25
6	1,9	10,6	16,4	24
7	2,2	10,8	16,6	23
8	2,5	11,1	16,7	22
9	2,8	11,3	16,8	21
10	3,1	11,6	16,9	20
11	3,4	11,8	17,0	19
12	3,7	12,0	17,1	18
13	4,0	12,3	17,2	17
14	4,4	12,5	17,3	16
15	4,7	12,7	17,4	15
16	5,0	13,0	17,5	14
17	5,3	13,2	17,5	13
18	5,6	13,4	17,6	12
19	5,9	13,6	17,7	11
20	6,1	13,8	17,7	10
21	6,4	14,0	17,8	9
22	6,7	14,2	17,8	8
23	7,0	14,4	17,9	7
24	7,3	14,6	17,9	6
25	7,6	14,7	17,9	5
26	7,9	14,9	18,0	4
27	8,2	15,1	18,0	3
28	8,4	15,3	18,0	2
29	8,7	15,4	18,0	1
30	9,0	15,6	18,0	0
S	11 +	10 +	9 +	S
S	5 —	4 —	3 —	S

I. For the MOON's Latitude.

Argument I. Long. ☽ in Orbit — Correct Long. ☊

S	0		1		2		S
	+		+		+		
S	6 —	Diff.	7 —	Diff.	8 —	Diff.	S
°	° ′ ″	′ ″	° ′ ″	′ ″	° ′ ″	′ ″	°
0	0 0 0,0	5 23,0	2 34 17,9	4 38,6	4 27 22,6	2 39,4	30
1	0 5 23,0	5 23,0	2 38 56,5	4 35,7	4 30 2,0	2 34,6	29
2	0 10 46,0	5 22,7	2 43 32,2	4 32,8	4 32 36,6	2 29,6	28
3	0 16 8,7	5 22,5	2 48 5,0	4 29,6	4 35 6,2	2 24,5	27
4	0 21 31,2	5 22,2	2 52 34,6	4 26,4	4 37 30,7	2 19,4	26
5	0 26 53,4	5 21,6	2 57 1,0	4 23,4	4 39 50,1	2 14,3	25
6	0 32 15,0	5 20,9	3 1 24,4	4 19,9	4 42 4,4	2 9,2	24
7	0 37 35,9	5 20,4	3 5 44,3	4 16,6	4 44 13,6	2 3,9	23
8	0 42 56,3	5 19,6	3 10 0,9	4 13,0	4 46 17,5	1 58,6	22
9	0 48 15,9	5 18,7	3 14 13,9	4 9,[illegible]	4 48 16,1	1 53,4	21
10	0 53 34,6	5 17,7	3 18 23,5	4 6,0	4 50 9,5	1 48,1	20
11	0 58 52,3	5 16,6	3 22 29,5	4 2,2	4 51 57,6	1 42,8	19
12	1 4 8,9	5 15,5	3 26 31,7	3 58,5	4 53 40,4	1 37,5	11
13	1 9 24,4	5 14,2	3 30 30,2	3 54,6	4 55 17,9	1 31,9	17
14	1 14 38,6	5 12,8	3 34 24,8	3 50,8	4 56 49,8	1 26,6	16
15	1 19 51,4	5 11,3	3 38 15,6	3 46,9	4 58 16,4	1 21,2	15
16	1 25 2,7	5 9,[illegible]	3 42 2,5	3 42,7	4 59 37,6	1 15,6	14
17	1 30 12,6	5 8,3	3 45 45,2	3 38,6	5 0 53,2	1 10,1	13
18	1 35 20,9	5 6,4	3 49 23,8	3 34,4	5 2 3,3	1 4,6	12
19	1 40 27,3	5 4,7	3 52 58,2	3 30,2	5 3 7,9	0 59,0	11
20	1 45 32,0	5 2,8	3 56 28,4	3 25,8	5 4 6,9	0 53,5	10
21	1 50 34,0	5 0,7	3 59 54,2	3 21,5	5 5 0,4	0 47,9	9
22	1 55 35,5	4 58,6	4 3 15,7	3 17,0	5 5 48,3	0 42,3	8
23	2 0 34,1	4 56,4	4 6 32,7	3 12,5	5 6 30,6	0 36,6	7
24	2 5 30,5	4 54,1	4 9 45,2	3 8,1	5 7 7,2	0 31,0	6
25	2 10 24,6	4 51,8	4 12 53,3	3 3,[illegible]	5 7 38,2	0 25,5	5
26	2 15 16,4	4 49,[illegible]	4 15 56,6	2 58,[illegible]	5 8 3,7	0 19,8	4
27	2 20 5,7	4 46,7	4 18 55,2	2 53,[illegible]	5 8 23,5	0 14,2	3
28	2 24 52,4	4 44,0	4 21 49,2	2 49,1	5 8 37,7	0 8,4	2
29	2 29 36,4	4 41,5	4 24 38,3	2 44,[illegible]	5 8 46,1	0 2,8	1
30	2 34 17,9		4 27 22,6		5 8 48,9		0
S	11 —		10 —		9 —		S
S	5 +		4 +		3 +		S

II. For the Moon's Latitude.

Arg. II. Do. Dist. ☽ in Orb. à ☉ — Ar. I.

S	0 +		1 +		2 +	
S	6 −	Dif.	7 −	Dif.	8 −	Dif.
°	′ ″	″	′ ″	″	′ ″	″
0	0 0,0	9,2	4 24,2	7,9	7 37,6	4,5
1	0 9,2	9,3	4 32,1	7,9	7 42,1	4,4
2	0 18,5	9,2	4 40,0	7,8	7 46,5	4,3
3	0 27,7	9,2	4 47,8	7,6	7 50,8	4,1
4	0 36,9	9,2	4 55,4	7,7	7 54,9	4,0
5	0 46,1	9,2	5 3,1	7,5	7 58,9	3,8
6	0 55,3	9,1	5 10,6	7,4	8 2,7	3,7
7	1 4,4	9,2	5 18,0	7,3	8 6,4	3,5
8	1 13,6	9,1	5 25,3	7,2	8 9,9	3,4
9	1 22,7	9,0	5 32,5	7,2	8 13,3	3,2
10	1 31,7	9,1	5 39,7	7,0	8 16,5	3,
11	1 40,8	9,0	5 46,7	6,9	8 19,6	2,9
12	1 49,8	9,1	5 53,6	6,8	8 22,5	2,8
13	1 58,9	8,9	6 0,4	6,7	8 25,3	2,6
14	2 7,8	8,9	6 7,1	6,6	8 27,9	2,5
15	2 16,7	8,9	6 13,7	6,4	8 30,4	2,3
16	2 25,6	8,9	6 20,1	6,4	8 32,7	2,2
17	2 34,5	8,8	6 26,5	6,2	8 34,9	2,0
18	2 43,3	8,7	6 32,7	6,1	8 36,9	1,8
19	2 52,0	8,7	6 38,8	6,0	8 38,7	1,7
20	3 0,7	8,7	6 44,8	5,9	8 40,4	1,5
21	3 9,4	8,6	6 50,7	5,7	8 41,9	1,4
22	3 18,0	8,5	6 56,4	5,6	8 43,3	1,2
23	3 26,5	8,4	7 2,0	5,5	8 44,5	1,0
24	3 34,9	8,4	7 7,5	5,3	8 45,5	0,9
25	3 43,3	8,4	7 12,8	5,2	8 46,4	0,7
26	3 51,7	8,2	7 18,0	5,1	8 47,1	0,6
27	3 59,9	8,2	7 23,1	5,0	8 47,7	0,4
28	4 8,1	8,1	7 28,1	4,8	8 48,1	0,2
29	4 16,2	8,0	7 32,9	4,7	8 48,3	0,1
30	4 24,2		7 37,6		8 48,4	
S	11 −		10 −		9 −	
S	5 +		4 +		3 +	

For the ☽'s Lat.

Argument III. Arg. I. — ☉'s M. A.

0 +	1 +	2 +	S
6 −	7 −	8 −	S
″	″	″	°
0,0	1,6	2,7	30
0,1	1,6	2,7	29
0,2	1,6	2,7	28
0,2	1,7	2,8	27
0,3	1,7	2,8	26
0,3	1,8	2,8	25
0,4	1,8	2,8	24
0,4	1,9	2,9	23
0,5	1,9	2,9	22
0,5	2,0	2,9	21
0,6	2,0	2,9	20
0,7	2,0	2,9	19
0,7	2,1	3,0	18
0,8	2,1	3,0	17
0,9	2,2	3,0	16
0,9	2,2	3,0	15
0,9	2,2	3,0	14
0,9	2,3	3,0	13
1,0	2,3	3,0	12
1,0	2,3	3,0	11
1,1	2,4	3,1	10
1,	2,4	3,1	9
1,2	2,4	3,1	8
1,2	2,5	3,1	7
1,	2,5	3,1	6
1,	2,5	3,1	5
1,4	2,6	3,1	4
1,	2,6	3,1	3
1,5	2,6	3,1	2
1,5	2,7	3,1	1
1,6	2,7	3,1	0
11 −	10 −	9 −	S
5 +	4 +	3 +	S

IV. For ☽'s Lat. — V. For ☽'s Lat. — VI. For ☽ La. — VII. For ☽'s Lat.

Argument IV. Ar. I. — ☽'s M. A. | Arg. V. A. IV. — ☽ M. A. | Arg. VI. A. V. — ☽ M. A. | Argument VII. Ar. II. + ☉'s M. A.

S	IV 0 −	IV 1 −	IV 2 −	V 0 −	V 1 −	V 2 −	VI 0 +	VI 1 +	VI 2 +	VII 0 −	VII 1 −	VII 2 −	S
S	6 +	7 +	8 +	6 +	7 +	8 +	6 −	7 −	8 −	6 +	7 +	8 +	S
°	″	″	″	″	″	″	″	″	″	″	″	″	°
0	0,0	8,8	15,2	0,0	12,6	21,7	0,0	1,0	1,7	0,0	4,5	7,8	30
1	0,3	9,0	15,3	0,4	12,9	22,0	0,0	1,0	1,7	0,2	4,6	7,9	29
2	0,6	9,3	15,5	0,9	13,3	22,2	0,1	1,0	1,7	0,3	4,8	8,0	28
3	0,9	9,5	15,6	1,3	13,7	22,4	0,1	1,0	1,7	0,5	4,9	8,0	27
4	1,2	9,8	15,8	1,8	14,0	22,6	0,2	1,1	1,7	0,6	5,0	8,1	26
5	1,5	10,0	16,0	2,2	14,4	22,8	0,2	1,1	1,7	0,8	5,2	8,2	25
6	1,8	10,	16,	2,6	14,8	22,9	0,2	1,1	1,7	0,9	5,3	8,2	24
7	2,	10,5	16,2	3,1	15,	23,1	0,2	1,1	1,7	1,1	5,4	8,3	23
8	2,4	0,	16,	3,5	15,5	23,	0,3	1,1	1,8	1,3	5,5	8,4	22
9	2,8	11,	16,4	3,9	15,8	23,4	0,3	1,2	1,8	1,4	5,7	8,4	21
10	3,1	11,	16,5	4,4	16,1	23,6	0,3	1,2	1,8	1,6	5,8	8,5	20
11	3,4	11,6	16,6	4,8	16,5	2 ,7	0,4	1,2	1,8	1,7	5,9	8,5	19
12	3,7	11,9	16,7	5,2	16,8	23,9	0,4	1,2	1,8	1,9	6,0	8,6	18
13	4,0	12,0	16,8	5,6	17,1	24,0	0,4	1,3	1,8	2,0	6,1	8,6	17
14	4,3	12,2	16,9	6,1	17,4	24,1	0,5	1,3	1,8	2,2	6,3	8,7	16
15	4,6	12,4	17,0	6,5	17,8	24,2	0,5	1,3	1,8	2,3	6,4	8,7	15
16	4,9	12,7	17,1	6,9	18,1	24,4	0,5	1,4	1,8	2,5	6,5	8,7	14
17	5,1	12,9	17,1	7,3	18,4	24,5	0,6	1,4	1,9	2,6	6,6	8,8	13
18	5,4	13,1	17,2	7,7	18,7	24,6	0,6	1,4	1,9	2,8	6,7	8,8	12
19	5,7	13,3	17,2	8,2	18,9	24,6	0,6	1,4	1,9	2,9	6,8	8,8	11
20	6,0	13,5	17,3	8,6	19,2	24,7	0,7	1,5	1,9	3,1	6,9	8,9	10
21	6,3	13,7	17,3	9,0	19,5	24,8	0,7	1,5	1,9	3,2	7,0	8,9	9
22	6,6	13,9	17,4	9,4	19,8	24,9	0,7	1,5	1,9	3,4	7,1	8,9	8
23	6,9	14,1	17,4	9,8	20,0	24,9	0,7	1,5	1,9	3,5	7,2	8,9	7
24	7,2	14,2	17,5	10,2	20,3	25,0	0,8	1,5	1,9	3,7	7,3	9,0	6
25	7,5	14,4	17,5	10,6	20,6	25,0	0,8	1,6	1,9	3,8	7,4	9,0	5
26	7,7	14,6	17,6	11,0	20,8	25,0	0,8	1,6	1,9	4,0	7,5	9,0	4
27	8,0	14,7	17,6	11,4	21,1	25,1	0,9	1,6	1,9	4,1	7,5	9,0	3
28	8,3	14,9	17,6	11,8	21,3	25,1	0,9	1,6	1,9	4,2	7,	9,0	2
29	8,5	15,0	17,6	12,2	21,5	25,1	0,9	1,6	1,9	4,4	7,7	9,0	1
30	8,8	15,2	17,6	12,6	21,7	25,1	1,0	1,7	1,9	4,5	7,8	9,0	0
S	11 +	10 +	9 +	11 +	10 +	9 +	11 −	10 −	9 −	11 +	10 +	9 +	S
S	5 −	4 −	3 −	5 −	4 −	3 −	5 +	4 +	3 +	5 −	4 −	3 −	S

VIII. For ☽ Lat. — IX. For ☽'s Lat. — X. For ☽'s Lat. — XI. For ☽'s Lat.

Arg. VIII. Arg. II. — ☉ M. A. | Arg. IX. Ar. II. + ☽ M. A. | Arg. X. Ar. II. — ☽ M. A. | Argument XI. Ar. X. — ☽'s M. A.

S	VIII 0 −	VIII 1 −	VIII −	IX 0 −	IX 1 −	IX 2 −	X 0 +	X 1 +	X 2 +	XI 0 −	XI 1 −	XI 2 −	S
S	6 +	7 +	8 +	6 +	7 +	8 +	6 −	7 −	8 −	6 +	7 +	8 +	S
°	″		″	″	″		″	″	″	″	″	″	°
0	0,0	1,9	3,2	0,0	1,1	1,	0,0	8,0	13,9	0,	2,6	4,5	30
1	0,1	1,9	3,2	0,0	1,1	1,	0,	8,2	13,9	0,	2,7	4,	29
2	0,1	2,	3,3	,	1,2	1,	0,	8,4	14,0	0,2	2,7	4,6	28
3	0,	2,	2,3	0,	1,2	2,	0,	8,	14,2	0,	2,9	4,6	27
4	0,3	2,1	3,3	0,1	1,2	2,0	1,1	8,9	14,3	0,4	2,	4,7	26
5	0,	2,1	3,4	0,2	1,3	2,0	1,	9,1	14,4	0,5	3,	4,7	25
6	0,4	2,2	2,	0,2	1,3	2,	1,7	9,4	14,5	0,	3,0	4,7	24
7	0,5	2,2	3,4	0,3	1,3	2,0	1,9	9,	14,6	0,6	3,	4,8	23
8	0,	2,	3,4	0,	1,4	2,0	2,2	9,	14,7	0,7	3,	4,8	22
9	0,6	2,3	3,5	0,4	1,	2,	2,5	10,	14,5	0,8	3,3	4,8	21
10	0,	2,4	,5	0,4	1,	2,	2,	10,	14,	0,	3,	4,9	20
11	0,7	2,4	3,5	0,4	1,4	2,	3,	10,	15,	1,0	3,4	4,9	19
12	0,8	2,5	3,5	0,5	1,5	2,1	3,	10,	15,1	1,1	3,5	4,9	18
13	0,8	2,5	3,5	0,5	1,5	2,1	3,6	10,	5,2	1,2	3,6	5,0	17
14	0,9	2,6	3,6	0,5	1,5	2,	3,	11,0	15,	1,	3,6	5,0	16
15	1,0	2,6	3,6	0,	1,6	2,	4,1	11,2	15,4	1,	3,7	5,0	15
16	1,0	2,7	3,6	0,	1,6	2,	4,	11,	15,4	1,	3,7	5,0	14
17	1,1	2,7	3,6	0,6	1,6	2,	4,	11,6	15,5	1,5	3,8	5,1	13
18	1,1	2,	3,6	0,7	1,6	2,2	4,	11,8	15,6	1,6	3,9	5,1	12
19	1,2	2,8	3,6	0,7	1,7	2,2	5,2	12,0	15,	1,7	3,9	5,1	11
20	1,3	2,8	3,6	0,8	1,7	2,2	5,4	12,2	15,7	1,8	4,0	5,1	10
21	1,3	2,9	3,7	0,8	1,7	2,2	5,7	12,4	15,7	1,9	4,0	5,1	9
22	1,4	2,9	3,7	0,8	1,7	2,2	6,0	12,5	15,7	2,0	4,1	5,1	8
23	1,4	3,0	3,7	0,9	1,8	2,2	6,2	12,7	15,8	2,0	4,2	5,2	7
24	1,5	3,0	3,7	0,9	1,8	2,2	6,5	12,9	15,8	2,1	4,2	5,2	6
25	1,6	3,0	3,7	0,9	1,8	2,2	6,7	13,0	15,8	2,2	4,3	5,2	5
26	1,6	3,1	3,7	1,0	1,8	2,2	7,0	13,2	15,9	2,3	4,3	5,2	4
27	1,7	3,1	3,7	1,0	1,9	2,2	7,2	13,3	15,9	2,4	4,4	5,2	3
28	1,7	3,1	3,7	1,0	1,9	2,2	7,5	13,4	15,9	2,4	4,4	5,2	2
29	1,8	3,2	3,7	1,1	1,9	2,2	7,7	13,6	15,9	2,5	4,5	5,2	1
30	1,9	3,2	3,7	1,1	1,9	2,2	8,0	13,8	15,9	2,6	4,5	5,2	0
S	11 +	10 +	9 +	11 +	10 +	9 +	11 −	10 −	9 −	11 +	10 +	9 +	S
S	5 −	4 −	3 −	5 −	4 −	3 −	5 +	4 +	3 +	5 −	4 −	3 −	S

I. For the Equatorial Parallax of the Moon.

Argument I.
Argument of Longitude I.
☉'s Mean Anomaly.

S	0	1	2	S
	+	+	+	
S	6	7	8	S
	—	—	—	
°	″	″	″	°
0	0,3	0,2	0,2	30
5	0,3	0,2	0,1	25
10	0,3	0,2	0,1	20
15	0,3	0,2	0,1	15
20	0,3	0,2	0,1	10
25	0,3	0,2	0,0	5
30	0,2	0,2	0,0	0
	+	+	+	
S	11	10	9	S
	—	—	—	
S	5	4	3	S

II. For the Equatorial Parallax of the Moon.

Argument II.
Argument of Longitude II.
2☽ à ☉ + ☽'s Mean Anomaly.

S	0	1	2	S
	—	—	—	
S	6	7	8	S
	+	+	+	
°	″	″	″	°
0	0,7	0,6	0,4	30
5	0,7	0,6	0,3	25
10	0,7	0,5	0,3	20
15	0,7	0,5	0,2	15
20	0,7	0,5	0,2	10
25	0,6	0,4	0,1	5
30	0,6	0,4	0,0	0
	—	—	—	
S	11	10	9	S
	+	+	+	
S	5	4	3	S

III. For the Equatorial Parallax of the Moon.

Argument III.
Argument of Longitude III.
2☽ à ☉ — ☽'s M. Anomaly.

S	0	1	2	S
	—	—	—	
S	6	7	8	S
	+	+	+	
°	″	″	″	″
0	0,8	0,7	0,4	30
5	0,8	0,7	0,3	25
10	0,8	0,6	0,3	20
15	0,8	0,6	0,2	15
20	0,8	0,5	0,2	10
25	0,7	0,5	0,1	5
30	0,7	0,4	0,0	0
	—	—	—	S
S	11	10	9	
	+	+	+	
S	5	4	3	S

IV. For the Equatorial Parallax of the Moon.

Argument IV.
Argument of Longitude IV.
2☽ à ☉ + ☽'s Mean Anomaly.

S	0	1	2	S
	+	+	+	
S	6	7	8	S
	—	—	—	
°	″	″	″	°
0	0,1	0,1	0,0	30
5	0,1	0,1	0,0	25
10	0,1	0,1	0,0	20
15	0,1	0,1	0,0	15
20	0,1	0,1	0,0	10
25	0,1	0,0	0,0	5
30	0,1	0,0	0,0	0
S	+	+	+	
	11	10	9	S
S	—	—	—	
	5	4	3	S

V. For the Equatorial Parallax of the Moon.

Argument V.
Argument of Longitude V.
2☽ à ☉ — ☽'s Mean Anomaly.

V. For the Equatorial Parallax of the Moon.
Argument V.
Argument of Longitude V.
2☽ à ☉ — ☽'s Mean Anomaly.

S	0	1	2	3	4	5	S
	—	—	—	+	+	+	
°	″	″	″	″	″	″	°
0	37,0	32,1	18,8	0,3	18,5	32,5	30
1	37,0	31,8	18,2	0,3	19,1	32,8	29
2	37,0	31,4	17,7	1,0	19,6	33,1	28
3	37,0	21,1	17,1	1,6	20,2	33,4	27
4	36,9	30,7	16,6	2,3	20,7	33,7	26
5	36,9	20,4	16,0	2,9	21,3	34,0	25
6	36,8	30,0	15,4	3,6	21,8	34,3	24
7	36,7	29,7	15,8	4,2	22,4	34,5	23
8	36,6	29,3	14,2	4,9	22,9	34,8	22
9	36,5	28,9	13,6	5,5	23,4	35,0	21
10	36,4	28,5	13,0	6,2	23,9	35,3	20
11	36,3	28,1	12,4	6,8	24,4	35,5	19
12	36,2	27,7	11,8	7,5	24,9	35,7	18
13	36,0	27,3	11,2	8,1	25,4	35,9	17
14	35,9	26,9	10,6	8,8	25,9	36,1	16
15	35,7	26,4	10,0	9 4	26,4	36,3	15
16	35,6	26,0	9,4	10,0	26,9	36,4	14
17	35,4	25,5	8,7	10,7	27,3	36,6	13
18	35,2	25,1	8,1	11,3	27,8	36,7	12
19	35,0	24,6	7,4	11,9	28,3	36,9	11
20	34,8	24,1	6,8	12,6	28,7	37,0	10
21	34,6	23,6	6,1	13,2	29,1	37,1	9
22	34,4	23,1	5,5	13,8	29,5	37,2	8
23	34,1	22,5	4,8	14,4	29,9	37,3	7
24	33,9	22,0	4,2	15,0	30,3	37,4	6
25	33,6	21,5	3,5	15,6	30,7	37,5	5
26	33,3	21,0	2,9	16,2	31,1	37,5	4
27	33,0	20,4	2,2	16,8	31,4	37,6	3
28	32,7	19,9	1,6	17,4	31,8	37,6	2
29	32,4	19,3	0,9	18,0	32,1	37,6	1
30	32,1	18,8	0,3	18,5	32,5	37,6	0
	—	—	—	+	+	+	
S	11	10	9	8	7	6	S

VI. For Equato. par. ☽

Argument VI.
Argument of Long. VI.
Arg. V. + Arg. I.

S	0	1	2	S
	+	+	+	
S	6	7	8	S
	—	—	—	
°	″	″	″	°
0	1,0	0,9	0,5	30
5	1,0	0,8	0,4	25
10	1,0	0,8	0,3	20
15	1,0	0,7	0,3	15
20	0,9	0,6	0,2	10
25	0,9	0,6	0,1	5
30	0,9	0,5	0,0	0
	+	+	+	
S	11	10	9	S
	—	—	—	
S	5	4	3	S

VII. For Equat. paral. ☽

Argument VII.
Argument of Long. VII.
Arg. V. — Arg. I.

S	0	1	2	S
	+	+	+	
S	6	7	8	S
	—	—	—	
°	″	″	″	°
0	0,6	0,5	0,3	30
5	0,6	0,5	0,3	25
10	0,6	0,4	0,2	20
15	0,6	0,4	0,2	15
20	0,6	0,4	0,1	10
25	0,5	0,3	0,1	5
30	0,5	0,3	0,0	0
	+	+	+	
S	11	10	9	S
	—	—	—	
S	5	4	3	S

VIII. For Equa. paral. ☽

Argument VIII.
Argument of Lon. VIII.
☽'s M. An. — ☉'s M. A.

S	0	1	2	S
	+	+	+	
S	6	7	8	S
	—	—	—	
°	″	″	″	°
0	0,2	0,2	0,1	30
5	0,2	0,2	0,1	25
10	0,2	0,2	0,1	20
15	0,2	0,1	0,1	15
20	0,2	0,1	0,0	10
25	0,2	0,1	0,0	5
30	0,2	0,1	0,0	0
	+	+	+	
S	11	10	9	S
	—	—	—	
S	5	4	3	S

IX. For the Equatorial Parallax of the Moon.

Argument IX.
Argument of Longitude IX.
M. Dist. ☽ à ☉ — ☽'s M. An.

S	0	1	2	3	4	5	S
	+	±	—	—	∓	+	
°	″	″	″	″	″	″	°
0	0,4	0,2	0,2	0,4	0,2	0,2	30
5	0,4	0,1	0,2	0,4	0,1	0,2	25
10	0,4	0,1	0,3	0,4	0,1	0,3	20
15	0,3	0,0	0,3	0,3	0,0	0,3	15
20	0,3	0,1	0,4	0,3	0,1	0,4	10
25	0,2	0,1	0,4	0,2	0,1	0,4	5
30	0,2	0,2	0,4	0,2	0,2	0,4	0
	+	+	—	—	∓	+	
S	11	10	9	8	7	6	S

X. For the Equatorial Parallax of the Moon.

Argument X.
Argument of Longitude X.
M. Long. ☊ — True Long. ☉

S	0	1	2	3	4	5	S
	+	±	—	—	∓	+	
°	″	″	″	″	″	″	°
0	2,2	1,2	0,9	2,0	1,1	0,8	30
5	2,1	0,9	1,2	2,0	0,8	1,1	25
10	2,0	0,5	1,4	1,9	0,5	1,3	20
15	1,9	0,1	1,6	1,8	0,1	1,5	15
20	1,7	0,2	1,8	1,6	0,2	1,6	10
25	1,5	0,6	1,9	1,4	0,5	1,7	5
30	1,2	0,9	2,0	1,1	0,8	1,8	0
	+	±	—	—	∓	+	
S	11	10	9	8	7	6	S

XI. For the Equatorial Parallax of the Moon.

Argument XI.
Argument of Longitude XI.
☽'s Correct Anomaly.

S	0 +	Dif.	1 +	Dif.	2 +	Dif.	3 +	Dif.	4 +	Dif.	5 +	Dif.
°	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″	′ ″	″
0	54 13,0	0,0	54 33,5	1,4	55 32,5	2,6	57 1,0	3,3	58 39,5	3,1	59 58,6	1,9
1	44 13,0	0,1	54 34,9	1,4	55 35,1	2,6	57 4,3	3,3	58 42,6	3,1	60 0,5	1,8
2	54 13,1	0,1	54 36,3	1,5	55 37,7	2,6	57 7,6	3,3	58 45,7	3,1	60 2,3	1,8
3	54 13,2	0,2	54 37,8	1,4	55 40,3	2,6	57 10,9	3,3	58 48,8	3,1	60 4,1	1,8
4	54 13,4	0,2	54 39,2	1,5	55 42,9	2,7	57 14,2	3,3	58 51,9	3,0	60 5,9	1,7
5	54 13,6	0,3	54 40,7	1,6	55 45,6	2,7	57 17,5	3,4	58 54,9	3,0	60 7,6	1,6
6	54 13,9	0,3	54 42,3	1,6	55 48,3	2,7	57 20,9	3,3	58 57,9	3,0	60 9,2	1,6
7	54 14,2	0,4	54 43,9	1,7	55 51,0	2,8	57 24,2	3,3	59 0,9	3,0	60 10,8	1,5
8	54 14,6	0,4	54 45,6	1,7	55 53,8	2,8	57 27,5	3,3	59 3,9	2,9	60 12,3	1,5
9	54 15,0	0,4	54 47,3	1,8	55 56,6	2,8	57 30,8	3,3	59 6,8	2,9	60 13,8	1,4
10	54 15,4	0,5	54 49,1	1,8	55 59,4	2,8	57 34,1	3,4	59 9,7	2,9	60 15,2	1,3
11	54 15,9	0,6	54 50,9	1,8	56 2,2	2,9	57 37,5	3,3	59 12,6	2,8	60 16,5	1,3
12	54 16,5	0,5	54 52,7	1,8	56 5,1	2,9	57 40,8	3,3	59 15,4	2,8	60 17,8	1,2
13	54 17,0	0,6	54 54,5	1,9	56 8,0	2,9	57 44,1	3,3	59 18,2	2,7	60 19,0	1,1
14	54 17,6	0,6	54 56,4	1,9	56 10,9	3,0	57 47,4	3,3	59 20,9	2,7	60 21,1	1,1
15	54 18,2	0,7	54 58,3	2,0	56 13,9	3,0	57 50,7	3,3	59 23,6	2,6	60 21,2	1,0
16	54 18,9	0,7	55 0,3	2,1	56 16,9	3,0	57 54,0	3,3	59 26,2	2,6	60 22,2	0,9
17	54 19,6	0,8	55 2,4	2,1	56 19,9	3,1	57 57,3	3,3	59 28,8	2,6	60 23,1	0,9
18	54 20,4	0,8	55 4,5	2,2	56 23,0	3,1	58 0,6	3,3	59 31,4	2,5	60 24,0	0,8
19	54 21,2	0,9	55 6,7	2,2	56 26,1	3,1	58 3,9	3,3	59 33,9	2,5	60 24,8	0,7
20	54 22,1	0,9	55 8,9	2,2	56 29,2	3,1	58 7,2	3,3	59 36,4	2,4	60 25,5	0,6
21	54 23,0	1,0	55 11,1	2,3	56 32,3	3,1	58 10,5	3,3	59 38,8	2,4	60 26,1	0,6
22	54 24,0	1,0	55 13,4	2,3	56 35,4	3,1	58 13,8	3,2	59 41,2	2,3	60 26,7	0,5
23	54 25,0	1,1	55 15,7	2,3	56 38,5	3,2	58 17,0	3,3	59 43,5	2,3	60 27,2	0,5
24	54 26,1	1,1	55 18,0	2,3	56 41,7	3,2	58 20,3	3,3	59 45,8	2,3	60 27,7	0,4
25	54 27,2	1,2	55 20,3	2,4	56 44,9	3,2	58 23,6	3,2	59 48,1	2,2	60 28,1	0,3
26	54 28,4	1,2	55 22,7	2,4	56 48,1	3,2	58 26,8	3,2	59 50,3	2,1	60 28,	0,3
27	54 29,6	1,3	55 25,1	2,4	56 51,3	3,2	58 30,0	3,2	59 52,4	2,1	60 28,7	0,2
28	54 30,9	1,3	55 27,5	2,5	56 54,5	3,2	58 33,2	3,2	59 54,5	2,1	60 28,9	0,1
29	54 32,2	1,3	55 30,0	2,5	56 57,7	3,3	58 36,4	3,1	59 56,6	2,0	60 29,0	0,0
30	54 33,5		55 32,5		57 1,0		58 39,5		59 58,6		60 29,0	
	+		+		+		+		+		+	
S	11		10		9		8		7		6	

XII. For Equat. Par. of the ☽

Argument XII.
Argument of Longitude XII.
☽'s Eq. Long.— ☉'s Tr. Lon.

0	1	2	3	4	5	S
+	±	−	−	±	+	
″	″	″	″	″	″	°
25,2	12,0	13,6	25,8	12,6	13,8	30
25,2	11,2	14,3	25,8	11,8	14,6	29
25,1	10,4	15,1	25,7	11,0	15,4	28
25,0	9,6	15,8	25,6	10,2	16,2	27
24,9	8,8	16,5	25,5	9,4	16,9	26
24,8	7,9	17,2	25,3	8,5	17,6	25
24,6	7,1	17,9	25,1	7,7	18,3	24
24,4	6,2	18,5	24,9	6,8	19,0	23
24,2	5,3	19,1	24,7	5,9	19,6	22
23,9	4,4	19,7	24,4	5,0	20,2	21
23,6	3,5	20,3	24,1	4,1	20,8	20
23,3	2,7	20,8	23,8	3,2	21,4	19
22,9	1,8	21,3	23,4	2,3	22,0	18
22,5	0,9	21,8	23,0	1,4	22,6	17
22,1	0,0	22,3	22,6	0,5	23,1	16
21,7	0,9	22,7	22,1	0,5	23,6	15
21,2	1,7	23,1	21,6	1,4	24,0	14
20,7	2,6	23,5	21,1	2,4	24,4	13
20,2	3,5	23,9	20,6	3,3	24,8	12
19,6	4,4	24,2	20,1	4,2	25,2	11
19,0	5,3	24,5	19,5	5,1	25,5	10
18,4	6,1	24,8	18,9	6,0	25,8	9
17,8	7,0	25,0	18,3	6,9	26,1	8
17,2	7,8	25,2	17,6	7,8	26,4	7
16,5	8,7	25,4	16,9	8,7	26,6	6
15,8	9,6	25,5	16,2	9,6	26,8	5
15,1	10,4	25,6	15,5	10,5	26,9	4
14,4	11,2	25,7	14,8	11,3	27,0	3
13,6	12,0	25,7	14,1	12,2	27,1	2
12,8	12,8	25,8	13,4	13,0	27,2	1
12,0	13,6	25 8	12,6	13,8	27,2	0
+	±	−	−	±	+	
11	10	9	8	7	6	S

XIII. For the Equatorial Parallax of the Moon.

Argument XIII.
Argument of Longitude XIII
☽. Eq. dist. ☽ à ☊ — ☽ Cor. A.

S	0 +	1 +	2 +	S
S	6 −	7 −	8 −	S
°	″	″	″	″
0	0,8	0,7	0,4	30
5	0,8	0,7	0,3	25
10	0,8	0,7	0 3	20
15	0,8	0,6	0 2	15
20	0,8	0,6	0,2	10
25	0,7	0,5	0,1	5
30	0,7	0 4	0 0	0
S	+ 11	+ 10	+ 9	S
S	− 5	− 4	− 3	S

For finding the Horizontal Parallax by the Equatorial Parallax.

Also for the Reduction of the Elevation of the Pole.

Argument.
Elev. of the Pole in lat. & below Eq. Par.

Elev. Pole.	Reduction of Paral. 54′ −	57′ −	60′ −	Red. of Ele. of the Pole. −	
°	″	″	″	′	″
0	0,0	0,0	0,0	0	0
6	0,2	0,2	0,2	3	6
12	0,6	0,7	0,7	6	4
18	1,4	1,4	1,5	8	57
24	2,3	2,5	2,6	11	6
30	3,5	3,7	3,9	12	56
36	4,9	5,1	5,4	14	12
42	6,3	6,7	7,0	14	51
48	7,7	8,2	8,6	14	51
54	9,2	9,7	10,2	14	12
60	10,5	11,1	11,7	12	56
66	11,7	12,4	13,0	11	6
72	12,7	13,4	14,1	8	57
78	13,4	14,2	14,9	6	4
84	13,9	14,6	15,4	3	6
90	14,1	14,8	15,6	0	0

For finding the Diameter of the Moon by the Equa. Paral.

Arg. Eq. Par		Equa Paral. ☽ Dia. ☽		Eq. Par		Dia. ☽	
′	″	′	″	′	″	′	″
54	0	29	25,8	58	0	31	36,6
54	10	29	31,2	58	10	31	42,0
54	20	29	36,7	58	20	31	47,5
54	30	29	42,1	58	30	31	52,9
54	40	29	47,6	58	40	31	58,4
54	50	29	53,0	58	50	32	3,8
55	0	29	58,5	59	0	32	9,3
55	10	30	3,9	59	10	32	14,7
55	20	30	9,4	59	20	32	20,2
55	30	30	14,8	39	30	32	25,6
55	40	30	20,3	59	40	32	31,1
55	50	30	25,7	59	50	32	36,5
56	0	30	31,2	60	0	32	42,0
56	10	30	36,6	60	10	32	47,4
56	20	30	42,1	60	20	32	52,9
56	30	30	47,5	60	30	32	58,3
56	40	30	53,0	60	40	33	3,8
56	50	30	58,4	60	50	33	9,2
57	0	31	3,9	61	0	33	14,7
57	10	31	9,3	61	10	33	20,1
57	20	31	14,8	61	20	33	25,6
57	30	31	20,2	61	30	33	31,0
57	40	31	25,7	61	40	33	36,5
57	50	31	31,1	61	50	33	41,9
58	0	31	36,6	62	0	33	47,3

I. For the Horary Motion of the Moon's Long.

Argument I.
Argument of Longitude I.

S	0	1	2	S
	+	+	+	
S	6	7	8	S
	—	—	—	
°	″	″		°
0	0,5	0,4	0,2	30
5	0,5	0,4	0,2	25
10	0,5	0,4	0,2	20
15	0,5	0,3	0,1	15
20	0,4	0,3	0,1	10
25	0,4	0,3	0,0	5
30	0,4	0,2	0,0	0
	+	+	+	
S	11	10	9	S
	—	—	—	
S	5	4	3	S

II. For the Horary Motion of the Moon's Long.

Argument II.
Argument of Longitude II.

S	0	1	2	S
	—	—	—	
S	6	7	8	S
	+	+	+	
°	″	″	″	°
0	1,0	0,9	0,5	30
5	1,0	0,8	0,4	25
10	1,0	0,8	0,3	20
15	1,0	0,7	0,3	15
20	0,9	0,6	0,2	10
25	0,9	0,6	0,1	5
30	0,9	0,5	0,0	0
	—	—	—	
S	11	10	9	S
	+	+	+	
S	5	4	3	S

III. For the Horary Motion of the Moon's Long.

Argument III.
Argument of Longitude III.

S	0	1	2	S
	—	—	—	
S	6	7	8	S
	+	+	+	
°	″	″	″	°
0	1,2	1,0	0,6	30
5	1,2	1,0	0,5	25
10	1,2	0,9	0,4	20
15	1,2	0,9	0,3	15
20	1,1	0,8	0,2	10
25	1,1	0,7	0,1	5
30	1,0	0,6	0,0	0
	—	—	—	S
S	11	10	9	
	+	+	+	
S	5	4	3	S

IV. For the Horary Motion of the Moon's Long.

Argument IV.
Argument of Longitude IV.

S	0	1	2	S
	—	—	—	
S	6	7	8	S
	+	+	+	
°	″	″	″	°
0	0,9	0,8	0,4	30
5	0,9	0,7	0,4	25
10	0,9	0,7	0,3	20
15	0,9	0,6	0,2	15
20	0,8	0,6	0,1	10
25	0,8	0,5	0,1	5
30	0,8	0,4	0,0	0
S	—	—	—	
	11	10	9	S
S	+	+	+	
	5	4	3	S

V. For the Horary Motion of the Moon's Longitude.

Argument V.
Argument of Longitude V.

S	0	1	2	3	4	5	S
	—	—	—	+	+	+	
°	″	″	″	″	″	″	°
0	41,4	36,1	21,3	0,6	20,7	36,7	30
1	41,4	35,7	20,7	0,1	21,4	37,1	29
2	41,4	35,3	20,1	0,9	22,0	37,4	28
3	41,3	34,9	19,4	1,6	22,7	37,8	27
4	41,3	34,5	18,8	2,4	23,3	38,2	26
5	41,2	34,1	18,1	3,1	23,9	38,5	25
6	41,2	33,7	17,5	3,8	24,5	38,8	24
7	41,1	33,3	16,8	4,6	25,1	39,1	23
8	41,0	32,9	16,1	5,3	25,7	39,4	22
9	40,9	32,5	15,5	6,0	26,3	39,7	21
10	40,8	32,0	14,9	6,7	26,9	39,9	20
11	40,6	31,6	14,2	7,5	27,5	40,2	19
12	40,5	31,1	13,5	8,2	28,0	40,4	18
13	40,4	30,7	12,8	8,9	28,6	40,7	17
14	40,2	30,2	12,1	9,7	29,1	40,9	16
15	40,0	29,7	11,4	10,4	29,7	41,1	15

V. For the Horary Motion of the Moon's Longitude.

Argument V.
Argument of Longitude V.

S	0	1	2	3	4	5	S
	—	—	—	+	+	+	
°	″	″	″	″	″	″	°
16	39,8	29,2	10,7	11,2	30,3	41,3	14
17	39,6	28,7	10,0	11,9	30,8	41,4	13
18	39,4	28,2	9,3	12,6	31,4	41,6	12
19	39,2	27,6	8,6	13,3	31,9	41,8	11
20	39,0	27,1	7,9	13,9	32,4	42,0	10
21	38,8	26,5	7,2	14,6	32,8	42,1	9
22	38,5	26,0	6,4	15,3	33,3	42,2	8
23	38,3	25,4	5,7	16,0	33,7	42,3	7
24	38,0	24,9	4,9	16,7	34,2	42,3	6
25	37,7	24,3	4,2	17,4	34,6	42,4	5
26	37,4	23,7	3,5	18,0	35,1	42,4	4
27	37,1	23,1	2,7	18,7	35,5	42,5	3
28	36,8	22,5	2,0	19,4	35,9	42,5	2
29	36,5	21,9	1,3	20,1	36,3	42,6	1
30	36,1	21,3	0,6	20,7	36,7	42,6	0
	—	—	—	+	+	+	
S	11	10	9	8	7	6	S

VI. For Hor. Mot. ☽ Lo.

Argument VI.
Argument of Long. VI.

S	0	1	2	S
	+	+	+	
S	6	7	8	S
	—	—	—	
°	″	″	″	°
0	1,1	0,9	0,5	30
5	1,1	0,9	0,5	25
10	1,1	0,8	0,4	20
15	1,0	0,8	0,3	15
20	1,0	0,7	0,2	10
25	1,0	0,6	0,1	5
30	0,9	0,5	0,0	0
	+	+	+	
S	11	10	9	S
	—	—	—	
S	5	4	3	S

VII. For Hor. Mot. ☽ Lo.

Argument VII.
Argument of Long. VII.

S	0	1	2	S
	+	+	+	
S	6	7	8	S
	—	—	—	
°	″	″	″	°
0	0,4	0,3	0,2	30
5	0,4	0,3	0,2	25
10	0,4	0,3	0,1	20
15	0,4	0,3	0,1	15
20	0,4	0,3	0,1	10
25	0,4	0,2	0,0	5
30	0,3	0,2	0,0	0
	+	+	+	
S	11	10	9	S
	—	—	—	
S	5	4	3	S

VIII. For Hor. Mot ☽ Lo.

Argument VIII.
Argument of Lon. VIII.

S	0	1	2	S
	+	+	+	
S	6	7	8	S
	—	—	—	
°	″	″	″	°
0	0,3	0,3	0,1	30
5	0,3	0,2	0,1	25
10	0,3	0,2	0,1	20
15	0,3	0,2	0,1	15
20	0,3	0,2	0,1	10
25	0,3	0,2	0,0	5
30	0,3	0,1	0,0	0
	+	+	+	
S	11	10	9	S
	—	—	—	
S	5	4	3	S

IX. For Horary Motion ☽'s Long.

Argument IX.
Argument of Longitude IX.

S	0	1	2	S
	—	—	—	
S	6	7	8	S
	+	+	+	
°	″	″	″	°
0	0,1	0,1	0,0	30
5	0,1	0,1	0,0	25
10	0,1	0,1	0,0	20
15	0,1	0,1	0,0	15
20	0,1	0,1	0,0	10
25	0,1	0,0	0,0	5
30	0,1	0,0	0,0	0
S	—	—	—	
	11	10	9	S
	+	+	+	
S	5	4	3	S

X. For the Horary Motion of the Moon's Long.

Argument X.
Argument of Longitude X.

S	0	1	2	3	4	5	S
	+	±	—	—	∓	+	
°	″	″	″	″	″	″	°
0	3,1	1,8	0,9	2,4	1,5	0,6	30
5	3,0	1,4	1,3	2,4	1,2	0,9	25
10	2,9	0,9	1,5	2,4	0,8	1,2	20
15	2,7	0,5	1,9	2,2	0,4	1,5	15
20	2,4	0,0	2,1	2,1	0,1	1,6	10
25	2,1	0,4	2,3	1,8	0,3	1,7	5
30	1,8	0,9	2,4	1,5	0,6	1,7	0
	+	±	—	—	∓	+	
S	11	10	9	8	7	6	S

XI. For the horary Motion of the Moon's Long.

Arg. XI. Argument of Longitude XI.

S	0	1	2	3	4	5
	+	+	+	+	+	+
°	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″
0	29 34,8	29 57,4	31 2,3	32 41,6	34 35,7	36 10,3
1	29 34,8	29 58,9	31 5,1	32 45,3	34 39,4	36 12,6
2	29 34,8	30 0,5	31 8,0	32 49,1	34 42,9	36 14,8
3	29 35,0	30 2,1	31 10,8	32 52,8	34 46,5	36 17,0
4	29 35,2	30 3,7	31 13,8	32 56,6	34 50,2	36 19,2
5	29 35,4	30 5,3	31 16,8	33 0,3	34 53,7	36 21,2
6	29 35,7	30 7,1	31 19,9	33 4,1	34 57,3	36 23,2
7	29 36,1	30 8,9	31 23,0	33 7,9	35 0,8	36 25,2
8	29 36,5	30 10,8	31 26,1	33 11,7	35 4,3	36 27,0
9	29 36,9	30 12,7	31 29,2	33 15,5	35 7,8	36 28,8
10	29 37,4	30 14,6	31 32,3	33 19,3	35 11,3	36 30,5
11	29 37,9	30 16,5	31 35,5	33 23,1	35 14,7	36 32,2
12	29 38,5	30 18,5	31 38,7	33 26,9	35 18,0	36 33,7
13	29 39,0	30 20,6	31 42,0	33 30,8	35 21,3	36 35,2
14	29 39,7	30 22,7	31 45,2	33 34,7	35 24,6	36 36,6
15	29 40,5	30 24,8	31 48,6	33 38,6	35 28,0	36 38,0
16	29 41,3	30 27,1	31 52,5	33 42,5	35 31,0	36 39,2
17	29 42,1	30 29,4	31 55,4	33 46,3	35 34,1	36 40,4
18	29 43,0	30 31,7	31 58,8	33 50,0	35 37,2	36 41,3
19	29 43,9	30 34,0	32 2,2	33 53,9	35 40,3	36 42,3
20	29 44,9	30 36,3	32 5,7	33 57,7	35 43,3	36 43,3
21	29 45,9	30 38,7	32 9,2	34 1,5	35 46,3	36 44,1
22	29 47,0	30 41,2	32 12,7	34 5,4	35 49,1	36 44,8
23	29 48,1	30 43,7	32 16,2	34 9,2	35 52,0	36 45,4
24	29 49,3	30 46,3	32 19,7	34 13,1	35 54,8	36 46,0
25	29 50,5	30 48,9	32 23,3	34 16,9	35 57,5	36 46,5
26	29 51,7	30 51,5	32 26,9	34 20,6	36 0,2	36 46,9
27	29 53,1	30 54,2	32 30,6	34 24,4	36 2,8	36 47,2
28	29 54,5	30 56,9	32 34,2	34 28,1	36 5,3	36 47,4
29	29 55,9	30 59,6	32 37,9	34 31,9	36 7,8	36 47,6
30	29 57,4	31 2,3	32 41,6	34 35,7	36 10,3	36 47,6
	+	+	+	+	+	+
S	11	10	9	8	7	6

XII. For the horary Motion of the Moon's Long.

Arg. XII. Argument of Longitude XII.

0	1	2	3	4	5	S
+	±	—	—	∓	+	
″	″	″	″	″	″	°
39,6	19,0	20,8	39,8	19,8	20,8	30
39,6	17,8	22,0	39,8	18,6	22,0	29
39,5	16,5	23,1	39,7	17,3	23,2	28
39,4	15,2	24,2	39,6	16,1	24,4	27
39,2	13,9	25,3	39,4	14,8	25,6	26
39,0	12,6	26,3	39,1	13,5	26,7	25
38,7	11,3	27,3	38,8	12,1	27,8	24
38,3	9,9	28,3	38,5	10,8	28,8	23
38,0	8,6	29,3	38,2	9,5	29,9	22
37,6	7,2	30,2	37,8	8,1	30,8	21
37,1	5,8	31,1	37,3	6,7	31,8	20
36,6	4,4	31,9	36,8	5,3	32,7	19
36,0	3,1	32,7	36,2	3,9	33,6	18
35,4	1,7	33,5	35,7	2,5	34,4	17
34,7	0,3	34,2	35,0	1,1	35,2	16
34,0	1,1	34,8	34,3	0,3	36,0	15
33,3	2,5	35,5	33,6	1,7	36,7	14
32,5	3,9	36,1	32,9	3,1	37,4	13
31,7	5,3	36,7	32,1	4,5	38,0	12
30,8	6,6	37,2	31,2	5,9	38,5	11
29,9	8,0	37,6	30,4	7,4	39,0	10
29,0	9,3	38,1	29,5	8,8	39,5	9
28,0	10,7	38,4	28,5	10,2	40,0	8
27,0	12,0	38,8	27,6	11,5	40,3	7
26,0	13,3	39,1	26,5	12,9	40,7	6
24,9	14,6	39,3	25,5	14,3	41,0	5
23,8	15,9	39,5	24,4	15,6	41,2	4
22,6	17,2	39,7	23,3	16,9	41,4	3
21,4	18,4	39,7	22,1	18,2	41,5	2
20,2	19,6	39,8	21,0	19,5	41,6	1
19,0	20,8	39,8	19,8	20,8	41,6	0
+	±	—	—	∓	+	
11	10	9	8	7	6	S

XIII. For the horary motion of ☽'s Long.

Arg. XIII. Arg. of Long. XIII.

S	0	1	2	S
	+	+	+	
S	6	7	8	S
	—	—	—	
°	″	″	″	°
0	0,8	0,7	0,4	30
5	0,8	0,7	0,3	25
10	0,8	0,6	0,3	20
15	0,8	0,6	0,2	15
20	0,8	0,5	0,2	10
25	0,7	0,5	0,1	5
30	0,7	0,4	0,0	0
	+	+	+	
S	11	10	9	S
	—	—	—	
S	5	4	3	S

For the horary Motion of the Moon's Longitude.

Arg. XIV. Argument of Longitude XIV.

S	0	1	2	S
	+	∓	+	
S	6	7	8	S
	—	∓	+	
°	″	″	″	°
0	7,7	3,8	3,8	30
1	7,7	3,6	4,1	29
3	7,7	3,4	4,3	28
5	7,7	3,1	4,5	27
4	7,6	2,9	4,7	26
5	7,6	2,6	4,9	25
6	7,5	2,4	5,1	24
7	7,4	2,1	5,3	23
8	7,4	1,9	5,5	22
9	7,3	1,6	5,7	21
10	7,2	1,3	5,9	20
11	7,1	1,1	6,1	19
12	7,0	0,8	6,2	18
13	6,9	0,5	6,4	17
14	6,8	0,3	6,5	16
15	6,7	0,0	6,7	15
16	6,5	0,3	6,8	14
17	6,4	0,5	6,9	13
18	6,2	0,8	7,0	12

S	0	1	2	S
	—	∓	+	
S	6	7	8	S
	—	∓	+	
°	″	″	″	°
19	6,1	1,1	7,1	11
20	5,9	1,3	7,2	10
21	5,7	1,6	7,3	9
22	5,5	1,9	7,4	8
23	5,3	2,1	7,5	7
24	5,1	2,4	7,5	6
25	4,9	2,6	7,6	5
26	4,7	2,9	7,6	4
27	4,5	3,1	7,7	3
28	4,3	3,4	7,7	2
29	4,1	3,6	7,7	1
30	3,8	3,8	7,7	0
	—	∓	+	
S	11	10	9	S
	—	∓	+	
S	5	4	3	S

The numbers taken from this Table ſhould be added or ſubtracted in the mean ratio of the Moon's horary motion, which is 32′ 56″, to the Moon's hourly motion juſt found, when it appeareth that operation is uſeful.

For the Horary Motion of the Moon's Latitude.

Argument I.
Argument of Latitude I.

S	0 +	1 +	2 +	S
S	6 —	7 —	8 —	S
°	′ ″	′ ″	′ ″	°
0	2 58,2	2 34,3	1 29,1	30
1	2 58,2	2 32,7	1 26,4	29
2	2 58,1	2 31,[illegible]	1 23,7	28
3	2 57,9	2 29,4	1 20,9	27
4	2 57,7	2 27,7	1 18,1	26
5	2 57,5	2 26,0	1 15,3	25
6	2 57,2	2 24,2	1 12,5	24
7	2 56,9	2 22,3	1 9,6	23
8	2 56,5	2 20,4	1 6,7	22
9	2 56,0	2 18,5	1 3,9	21
10	2 55,5	2 16,5	1 1,0	20
11	2 54,9	2 14,5	0 58,0	19
12	2 54,3	2 12,4	0 55,1	18
13	2 53,6	2 10,3	0 52,1	17
14	2 52,9	2 8,2	0 49,1	16
15	2 52,1	2 6,0	0 46,1	15
16	2 51,3	2 3,8	0 43,1	14
17	2 50,4	2 1,5	0 40,1	13
18	2 49,5	1 59,2	0 37,0	12
19	2 48,5	1 56,9	0 34,0	11
20	2 47,4	1 54,5	0 30,9	10
21	2 46,4	1 52,1	0 27,9	9
22	2 45,2	1 49,7	0 24,8	8
23	2 44,0	1 47,2	0 21,7	7
24	2 42,8	1 44,7	0 18,6	6
25	2 41,5	1 42,2	0 15,5	5
26	2 40,2	1 39,6	0 12,4	4
27	2 38,8	1 37,0	0 9,3	3
28	2 37,3	1 34,4	0 6,2	2
29	2 35,9	1 31,8	0 3,1	1
30	2 34,3	1 29,1	0 0,0	0
S	+ 11	+ 10	+ 9	S
S	— 5	— 4	— 3	S

Argument II.
Argument of Latitude II.

S	0 +	1 +	2 +	S
S	6 —	7 —	8 —	S
°	″	″	″	°
0	4,3	3,7	2,1	30
1	4,3	3,7	2,1	29
2	4,3	3,6	2,0	28
3	4,3	3,6	1,9	27
4	4,3	3,5	1,9	26
5	4,3	3,5	1,8	25
6	4,3	3,4	1,7	24
7	4,3	3,4	1,7	23
8	4,3	3,4	1,6	22
9	4,2	3,3	1,5	21
10	4,2	3,3	1,5	20
11	4,2	3,2	1,4	19
12	4,2	3,2	1,3	18
13	4,2	3,1	1,2	17
14	4,1	3,1	1,2	16
15	4,1	3,0	1,1	15
16	4,1	3,0	1,0	14
17	4,1	2,9	1,0	13
18	4,1	2,9	0,9	12
19	4,1	2,8	0,8	11
20	4,0	2,7	0,7	10
21	4,0	2,7	0,7	9
22	4,0	2,6	0,6	8
23	4,0	2,6	0,5	7
24	3,9	2,5	0,5	6
25	3,9	2,4	0,4	5
26	3,8	2,4	0,3	4
27	3,8	2,3	0,2	3
28	3,8	2,3	0,1	2
29	3,8	2,2	0,1	1
30	3,7	2,1	0,0	0
S	+ 11	+ 10	+ 9	S
S	— 5	— 4	— 3	S

The quantity and difference of these Equations, as the sign signifies, is increased or diminished in proportion to the mean horary motion of the Moon, which is 32′. 56″, to the horary motion of the Moon in her proper orbit.

SECT. XI. *The method of finding the Longitude by the Eclipses of Jupiter's Satellites; the amazing Velocity of Light demonstrated by these Eclipses; and of Cometary Eclipses.*

IN the former section, having explained at great length how eclipses of the sun and moon happen at certain times, it must be evident, that similar eclipses will be observed by the inhabitants of Jupiter and Saturn, which are attended by so many moons. These eclipses indeed very frequently happen to the satellites of Jupiter; and as they are of the greatest service in determining the longitude of places on this earth, astronomers have been at great pains to calculate tables for the eclipses of these satellites by their primary, for the satellites themselves have never been observed to eclipse one another. The construction of such tables is indeed much easier for these satellites than of any other celestial bodies, as their motions are much more regular.

482 Frequency of these eclipses.

The English tables are calculated for the meridian of Greenwich, and by these it is very easy to find how many degrees of longitude any place is distant either east or west from Greenwich; for, let an observer, who has these tables, with a good telescope and a well-regulated clock at any other place of the earth, observe the beginning or ending of an eclipse of one of Jupiter's satellites, and note the precise moment of time that he saw the satellite either immerge into, or emerge out of the shadow, and compare that time with the time shown by the tables for Greenwich; then 15 degrees difference of longitude being allowed for every hour's difference of time, will give the longitude of that place from Greenwich; and if there be any odd minutes of time, for every minute a quarter of a degree, east or west, must be allowed, as the time of observation is later or earlier than the time shown by the tables. Such eclipses are very convenient for this purpose at land, because they happen almost every day; but are of no use at sea, because the rollings of the ship hinders all nice telescopical observations.

Fig. 177.

To explain this by a figure, let J be Jupiter, K, L, M, N his four satellites in their respective orbits, 1, 2, 3, 4; and let the earth be at F (suppose in November, although that month is no otherwise material than to find the earth readily in this scheme, where it is shown in eight different parts of the orbit). Let Q be a place on the meridian of Greenwich, and R a place on some other meridian eastward from Greenwich. Let a person at R observe the instantaneous vanishing of the first satellite K into Jupiter's shadow, suppose at three o'clock in the morning; but by the tables he finds the immersion of that satellite to be at midnight at Greenwich; he then can immediately determine, that as there are three hours difference of time between Q and K, and that R is three hours forwarder in reckoning than Q, it must be 45 degrees of east longitude from the meridian of Q. Were this method as practicable at sea as at land, any sailor might almost as easily, and with equal certainty, find the longitude as the latitude.

483 When the immersions or emersions are to be observed.

Whilst the earth is going from C to F in its orbit, only the immersions of Jupiter's satellites into his shadow are generally seen; and their emersions out of it while the earth goes from G to B. Indeed, both these appearances may be seen of the second, third, and fourth satellite when eclipsed, whilst the earth is between D and E, or between G and A; but never of the first satellite, on account of the smallness of its orbit and the bulk of Jupiter, except only when Jupiter is directly opposite to the sun, that is, when the earth is at G; and even then, strictly speaking, we cannot see either the immersions or emersions of any of his satellites, because his body being directly between us and his conical shadow, his satellites are hid by his body a few moments before they touch his shadow; and are quite emerged from thence before we can see them, as it were just dropping from him. And when the earth is at C, the sun, being between it and Jupiter, hides both him and his moons from us.

In this diagram, the orbits of Jupiter's moons are drawn in true proportion to his diameter; but in proportion to the earth's orbit, they are drawn vastly too large.

In whatever month of the year Jupiter is in conjunction with the sun, or in opposition to him, in the next year it will be a month later at least. For whilst the earth goes once round the sun, Jupiter describes a twelfth part of his orbit. And therefore, when the earth has finished its annual period, from being in a line with the sun and Jupiter, it must go as much forwarder as Jupiter has moved in that time, to overtake him again; just like the minute-hand of a watch, which must, from any conjunction with the hour-hand, go once round the dial-plate and somewhat above a twelfth part more, to overtake the hour-hand again.

484 Velocity of light.

It is found by observation, that when the earth is between the sun and Jupiter, as at G, his satellites are eclipsed about 8 minutes sooner than they should be according to the tables; and when the earth is at B or C, these eclipses happen about 8 minutes later than the tables predict them. Hence it is undeniably certain, that the motion of light is not instantaneous, since it takes about $16\frac{1}{2}$ minutes of time to go through a space equal to the diameter of the earth's orbit, which is 180,000,000 of miles in length; and consequently the particles of light fly almost 200,000 miles every second of time, which is above a milion of times swifter than the motion of a cannon bullet. And as light is $16\frac{1}{2}$ minutes in travelling across the earth's orbit, it must be $8\frac{1}{4}$ minutes in coming from the sun to us: therefore if the sun were annihilated, we should see him for $8\frac{1}{4}$ minutes after; and if he were again created, he would be $8\frac{1}{4}$ minutes old before we could see him.

Fig. 178.

To illustrate this progressive motion of light, let A and B be the earth in two different parts of its orbit, whose distance from each other is 95,000,000 of miles, equal to the earth's distance from the sun S. It is plain, that if the motion of light were instantaneous, the satellite 1 would appear to enter into Jupiter's shadow FF at the same moment of time to a spectator in A, as to another in B. But by many years observations it has been found, that the immersion of the satellite into the shadow is seen $8\frac{1}{4}$ minutes sooner when the earth is at B than when it is at A. And so, as Mr Romeur first discovered, the motion of light is thereby proved to be progressive, and not instanta-

neous,

Eclipses of Jupiter's Satellites.

neous, as was formerly believed. It is easy to compute in what time the earth moves from A to B; for the chord of 60 degrees of any circle is equal to the semidiameter of that circle: and as the earth goes through all the 360 degrees of its orbit in a year, it goes through 60 of those degrees in about 61 days. Therefore, if on any given day, suppose the first of June, the earth is at A, on the first of August it will be at B; the chord, or straight line AB, being equal to DS the radius of the earth's orbit, the same with AS its distance from the sun.

As the earth moves from D to C, thro' the side AB of its orbit, it is constantly meeting the light of Jupiter's satellites sooner, which occasions an apparent acceleration of their eclipses; and as it moves through the other half H of its orbit, from C to D, it is receding from their light, which occasions an apparent retardation of their eclipses, because their light is then longer before it overtakes the earth.

485 Acceleration of these eclipses not owing to any inequality in the motions of the satellites.

That these accelerations of the immersions of Jupiter's satellites into his shadow, as the earth approaches towards Jupiter, and the retardations of their emersions out of his shadow, as the earth is going from him, are not occasioned by any inequality arising from the motions of the satellites in eccentric orbits, is plain, because it affects them all alike, in whatever parts of their orbits they are eclipsed. Besides, they go often round their orbits every year, and their motions are no way commensurate to the earth's. Therefore, a phenomenon not to be accounted for from the real motions of the satellites, but so easily deducible from the earth's motion, and so answerable thereto, must be allowed to result from it. This affords one very good proof of the earth's annual motion.

486 Eclipses by comets.

From what we have said in general concerning eclipses, it is plain that secondary planets are not the only bodies that may occasion them. The primary planets would eclipse one another, were it not for their great distances; but as the comets are not subject to the same laws with the planets, it is possible they may sometimes approach so near to the primary planets, as to cause an eclipse of the sun to those planets; and as the body of a comet bears a much larger proportion to the bulk of a primary planet than any secondary, it is plain that a cometary eclipse would both be of much longer continuance, and attended with much greater darkness, than that occasioned by a secondary planet. This behoved to be the case at any rate: but if we suppose the primary planet and comet to be moving both the same way, the duration of such an eclipse would be prodigiously lengthened; and thus, instead of four minutes, the sun might be totally darkened to the inhabitants of certain places for as many hours. Hence we may account for that prodigious darkness which we sometimes read of in history at times when no eclipse of the sun by the moon could possibly happen. It is remarkable, however, that no comet hath ever been observed passing over the disk of the sun like a spot, as Venus and Mercury are; yet this must certainly happen, when the comet is in its perihelion, and the earth on the same side of its annual orbit. Such a phenomenon well deserves the watchful attention of astronomers, as it would be a greater confirmation of the planetary nature of comets than any thing hitherto observed.

Astronomical Machinery.

SECT. XII. *A Description of the Astronomical Machinery serving to explain and illustrate the foregoing part of this Treatise.*

The machine represented by fig. 207. is the GRAND ORRERY, first made in this kingdom by Mr Rowley for King George I. The frame of it, which contains the wheel-work, &c. and regulates the whole machine, is made of ebony, and about four feet in diameter; the outside thereof is adorned with 12 pilastres. Between these the 12 signs of the zodiac are neatly painted with gilded frames. Above the frame is a broad ring supported with 12 pillars. This ring represents the plane of the ecliptic; upon which are two circles of degrees, and between these the names and characters of the 12 signs. Near the outside is a circle of months and days, exactly corresponding to the sun's place at noon each day throughout the year. Above the ecliptic stand some of the principal circles of the sphere, agreeable to their respective situations in the heavens: viz. N° 10. are the two colures, divided into degrees and half degrees; N° 11. is one-half of the equinoctial circle, making an angle of $23\frac{1}{2}$ degrees. The tropic of cancer and the arctic circle are each fixed parallel at their proper distance from the equinoctial. On the northern half of the ecliptic is a brass semicircle, moveable upon two points fixed in ♈ and ♎. This semicircle serves as a moveable horizon to be put to any degree of latitude upon the north part of the meridian, and the whole machine may be set to any latitude without disturbing any of the internal motions, by two strong hinges (N° 13.) fixed to the bottom-frame upon which the instrument moves, and a strong brass arch, having holes at every degree, through which a strong pin is put at every elevation. This arch and the two hinges support the whole machine when it is lifted up according to any latitude; and the arch at other times lies conveniently under the bottom-frame. When the machine is set to any latitude (which is easily done by two men, each taking hold of two handles conveniently fixed for the purpose), set the moveable horizon to the same degree upon the meridian, and hence you may form an idea of the respective altitude or depression of the planets both primary and secondary. The sun (N° 1.) stands in the middle of the whole system upon a wire, making an angle with the ecliptic of about 82 degrees. Next the sun is a small ball (2.), representing Mercury. Next to Mercury is Venus (3.), represented by a larger ball. The earth is represented (N° 4.) by an ivory ball, having some circles and a map sketched upon it. The wire which supports the earth makes an angle with the ecliptic of $66\frac{1}{2}$ degrees, the inclination of the earth's axis to the ecliptic. Near the bottom of the earth's axis is a dial-plate (N° 9.), having an index pointing to the hours of the day as the earth turns round its axis. Round the earth is a ring supported by two small pillars, representing the orbit of the moon; and the divisions upon it answer to the moon's latitude. The motion of this ring represents the motion of the moon's orbit according to that of the nodes. Within this ring is the moon (N° 5.), having a black cap or case, by which its motion represents the phases of the moon according to her age. Without the orbits of the

Astronomical Machinery.

the earth and moon is Mars (N° 6.) The next in order to Mars is Jupiter and his four moons (N° 7.) Each of these moons is supported by a wire fixed in a socket which turns about the pillar supporting Jupiter. These satellites may be turned by the hand to any position, and yet when the machine is put into motion they will all move in their proper times. The outermost of all is Saturn, his five moons, and his ring (N° 8.). These moons are supported and contrived similar to those of Jupiter. The machine is put into motion by turning a small winch (N° 14,); and the whole system is also moved by this winch, and by pulling out and pushing in a small cylindrical pin above the handle. When it is pushed in, all the planets, both primary and secondary, will move according to their respective periods by turning the handle. When it is drawn out, the motions of the satellites of Jupiter and Saturn will be stopped while all the rest move without interruption. There is also a brass lamp having two convex glasses to be put in room of the sun; and also a smaller earth and moon, made somewhat in proportion to their distance from each other, which may be put on at pleasure. The lamp turns round at the same time with the earth, and the glasses of it cast a strong light upon her. And when the smaller earth and moon are placed on, it will be easy to show when either of them will be eclipsed. When this machine is intended to be used, the planets must be duly placed by means of an ephemeris hereafter described; and you may place a small black patch or bit of wafer upon the middle of the sun. Right against the first degree of ♈, you may also place patches upon Venus, Mars, and Jupiter, right against some noted point in the ecliptic. Put in the handle, and push in the pin which is above it. One turn of this handle answers to a revolution of the ball which represents the earth about its axis; and consequently to 24 hours of time, as shown by the hour-index (9.), which is marked and placed at the foot of the wire on which the ball of the earth is fixed. Again, when the index has moved the space of ten hours, Jupiter makes one revolution round its axis, and so of the rest. By these means the revolutions of the planets, and their motions round their own axes, will be represented to the eye. By observing the motions of the spots upon the surface of the sun and of the planets in the heavens, their diurnal motion was first discovered, after the same manner as we in this machine observe the motions of their representatives by that of the marks placed upon them.

488 The Orrery (fig. 208.) is a machine contrived by the late ingenious Mr James Ferguson. It shows the motions of the sun, Mercury, Venus, earth, and moon; and occasionally the superior planets, Mars, Jupiter, and Saturn, may be put on. Jupiter's four satellites are moved round him in their proper times by a small winch; and Saturn has his five satellites, and his ring which keeps its parallelism round the sun; and by a lamp put in the sun's place, the ring shows all its various phases already described.

In the centre, N° 1. represents the sun, supported by its axis, inclining almost 8 degrees from the axis of the ecliptic, and turning round in $25\frac{1}{4}$ days on its axis, of which the north pole inclines toward the eighth degree of Pisces in the great ecliptic (N° 11.), whereon the months and days are engraven over the signs and degrees in which the sun appears, as seen from the earth, on the different days of the year.

The nearest planet (N° 2.) to the sun is Mercury, which goes round him in 87 days 23 hours, or $87\frac{23}{24}$ diurnal rotations of the earth; but has no motion round its axis in the machine, because the time of its diurnal motion in the heavens is not known to us.

The next planet in order is Venus (N° 3.), which performs her annual course in 224 days 17 hours, and turns round her axis in 24 days 8 hours, or in $24\frac{1}{3}$ diurnal rotations of the earth. Her axis inclines 75 degrees from the axis of the ecliptic, and her north pole inclines towards the 20th degree of Aquarius, according to the observations of Bianchini. She shows all the phenomena described in Sect. ii.

Next, without the orbit of Venus, is the earth (N° 4.), which turns round its axis, to any fixed point at a great distance, in 23 hours 56 minutes 4 seconds of mean solar time; but from the sun to the sun again, in 24 hours of the same time. N° 6. is a sidereal dial-plate under the earth, and N° 7. a solar dial-plate on the cover of the machine. The index of the former shows sidereal, and of the latter, solar time; and hence the former index gains one entire revolution on the latter every year, as 365 solar or natural days contain 366 sidereal days, or apparent revolutions of the stars. In the time that the earth makes $365\frac{1}{4}$ diurnal rotations on its axis, it goes once round the sun in the plane of the ecliptic; and always keeps opposite to a moving index (N° 10.) which shows the sun's daily change of place, and also the days of the months.

The earth is half covered with a black cap, for dividing the apparently enlightened half next the sun from the other half, which, when turned away from him, is in the dark. The edge of the cap represents the circle bounding light and darkness, and shows at what time the sun rises and sets to all places throughout the year. The earth's axis inclines $23\frac{1}{2}$ degrees from the axis of the ecliptic: the north pole inclines toward the beginning of Cancer, and keeps its parallelism throughout its annual course; so that in summer the northern parts of the earth incline towards the sun, and in winter from him: by which means, the different length of days and nights, and the cause of the various seasons, are demonstrated to sight.

There is a broad horizon, to the upper side of which is fixed a meridian semicircle in the north and south points, graduated on both sides from the horizon to 90° in the zenith or vertical point. The edge of the horizon is graduated from the east and west to the south and north points, and within these divisions are the points of the compass. From the lower side of this thin horizontal plate stand out four small wires, to which is fixed a twilight-circle 18 degrees from the graduated side of the horizon all round. This horizon may be put upon the earth (when the cap is taken away), and rectified to the latitude of any place; and then by a small wire called the *solar ray*, which may be put on so as to proceed directly from the sun's centre towards the earth's, but to come no farther than almost to touch the horizon. The beginnnig of twilight, time of sun-rising, with his amplitude, meridian altitude, time of setting, amplitude then, and end of twilight, are shown for every day of the year, at that place to which the horizon is rectified.

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The moon (N° 5.) goes round the earth, from between it and any fixed point at a great diſtance, in 27 days 7 hours 43 minutes, or through all the ſigns and degrees of her orbit, which is called her *periodical revolution;* but ſhe goes round from the ſun to the ſun again, or from change to change, in 29 days 12 hours 35 minutes, which is her *ſynodical revolution;* and in that time ſhe exhibits all the phaſes already deſcribed.

When the abovementioned horizon is rectified to the latitude of any given place, the times of the moon's riſing and ſetting, together with her amplitude, are ſhown to that place as well as the ſun's; and all the various phenomena of the harveſt-moon are made obvious to ſight.

The moon's orbit (N° 9.) is inclined to the ecliptic (N° 11.), one-half being above and the other below it. The nodes, or points at ☊ and ☋, lie in the plane of the ecliptic, as before deſcribed, and ſhift backward through all its ſines and degrees in 18⅔ years. The degrees of the moon's latitude to the higheſt at NL (north latitude) and loweſt at SL (ſouth latitude), are engraven both ways from her nodes at ☊ and ☋, and as the moon riſes and falls in her orbit according to its inclination, her latitude and diſtance from her nodes are ſhown for every day, having firſt rectified her orbit ſo as to ſet the nodes to their proper places in the ecliptic; and then as they come about at different and almoſt oppoſite times of the year, and then point towards the ſun, all the eclipſes may be ſhown for hundreds of years (without any new rectification), by turning the machinery backward for time paſt, or forward for time to come. At 17 degrees diſtance from each node, on both ſides, is ingraved a ſmall ſun; and at 12 degrees diſtance, a ſmall moon, which ſhow the limits of ſolar and lunar eclipſes; and when, at any change, the moon falls between either of theſe ſuns and the node, the ſun will be eclipſed on the day pointed to by the annual index (N° 10.); and as the moon has then north or ſouth latitude, one may eaſily judge whether that eclipſe will be viſible in the northern or ſouthern hemiſphere: eſpecially as the earth's axis inclines toward the ſun or from him at that time. And when at any full the moon falls between either of the little moon's and node, ſhe will be eclipſed, and the annual-index ſhows the day of that eclipſe. There is a circle of 29½ equal parts (N° 8.) on the cover of the machine, on which an index ſhows the days of the moon's age.

There are two ſemicircles (fig. 216.) fixed to an elliptical ring, which being put like a cap upon the earth, and the forked part F upon the moon, ſhows the tides as the earth turns round within them, and they are led round it by the moon. When the different places come to the ſemicircle A*a*E*b*B, they have tides of flood; and when they come to the ſemicircle CED, they have tides of ebb; the index on the hour-circle (fig. 208.) ſhowing the times of theſe phenomena.

There is a jointed wire, of which one end being put into a hole in the upright ſtem that holds the earth's cap, and the wire laid into a ſmall forked piece which may be occaſionally put upon Venus or Mercury, ſhows the direct and retrograde motions of theſe two planets, with their ſtationary times and places, as ſeen from the earth.

The whole machinery is turned by a winch or handle (N° 12.); and is ſo eaſily moved, that a clock might turn it without any danger of ſtopping.

To give a plate of the wheel-work of this machine would anſwer no purpoſe, becauſe many of the wheels lie ſo behind others as to hide them from ſight in any view whatever.

489 The Planetarium (fig. 209.) is an inſtrument contrived by Mr William Jones of Holburn, London, mathematical inſtrument maker, who has paid conſiderable attention to thoſe ſort of machines, in order to reduce them to their greateſt degree of ſimplicity and perfection. It repreſents, in a general manner, by various parts of its machinery, all the motions and phenomena of the planetary ſyſtem. This machine conſiſts of, the Sun (in the centre), with the planets, Mercury, Venus, the Earth and Moon, Mars, Jupiter and his four moons, Saturn and his five moons; and to it is occaſionally applied an extra long arm for the Georgian planet and his two moons. To the earth and moon is applied a frame CD, containing only four wheels and two pinions, which ſerve to preſerve the earth's axis in its proper paralleliſm in its motion round the ſun, and to give the moon her due revolution about the earth at the ſame time. Theſe wheels are connected with the wheel-work in the round box below, and the whole is ſet in motion by the winch H. The arm M that carries round the moon, points out on the plate C her age and phaſes for any ſituation in her orbit, and which accordingly are engraved thereon. In the ſame manner the arm points out her place in the ecliptic B, in ſigns and degrees, called her geocentric place; that is, as ſeen from the earth. The moon's orbit is repreſented by the flat rim A; the two joints of which, and upon which it turns, denoting her nodes. This orbit is made to incline to any deſired angle. The earth of this inſtrument is uſually made of a three inch or 1½ globe, papered, &c. for the purpoſe; and by means of the terminating wire that goes over it, points out the changes of the ſeaſons, and the different lengths of days and nights more conſpicuouſly. This machine is alſo made to repreſent the Ptolemaic Syſtem, or ſuch as is vulgarly received; which places the earth in the centre, and the planets and ſun revolving about it. (It is done by an auxiliary ſmall ſun and an earth, which change their places in the inſtrument.) At the ſame time, it affords a moſt manifeſt confutation of it: for it is plainly obſerved by this conſtruction, (1.) That the planets Mercury and Venus being both within the orbit of the ſun, cannot at any time be ſeen to go behind it; whereas in nature we obſerve them as often to go behind as before the ſun in the heavens. (2.) It ſhows, that as the planets move in circular orbits about the central earth, they ought at all times to be of the ſame apparent magnitude; whereas, on the contrary, we obſerve their apparent magnitude in the heavens to be very variable, and ſo far different, that, for inſtance, Mars will ſometimes appear as big as Jupiter nearly, and at other times you will ſcarcely know him from a fixed ſtar. (3.) It ſhows that any of the planets might be ſeen at all diſtances from the ſun in the heavens; or, in other words, that when the ſun is ſetting, Mercury or Venus may be ſeen not only in the ſouth but even in the eaſt; which circumſtances were never yet obſerved. (4.) You

Fig. 207 The GRAND ORRERY by Rowley

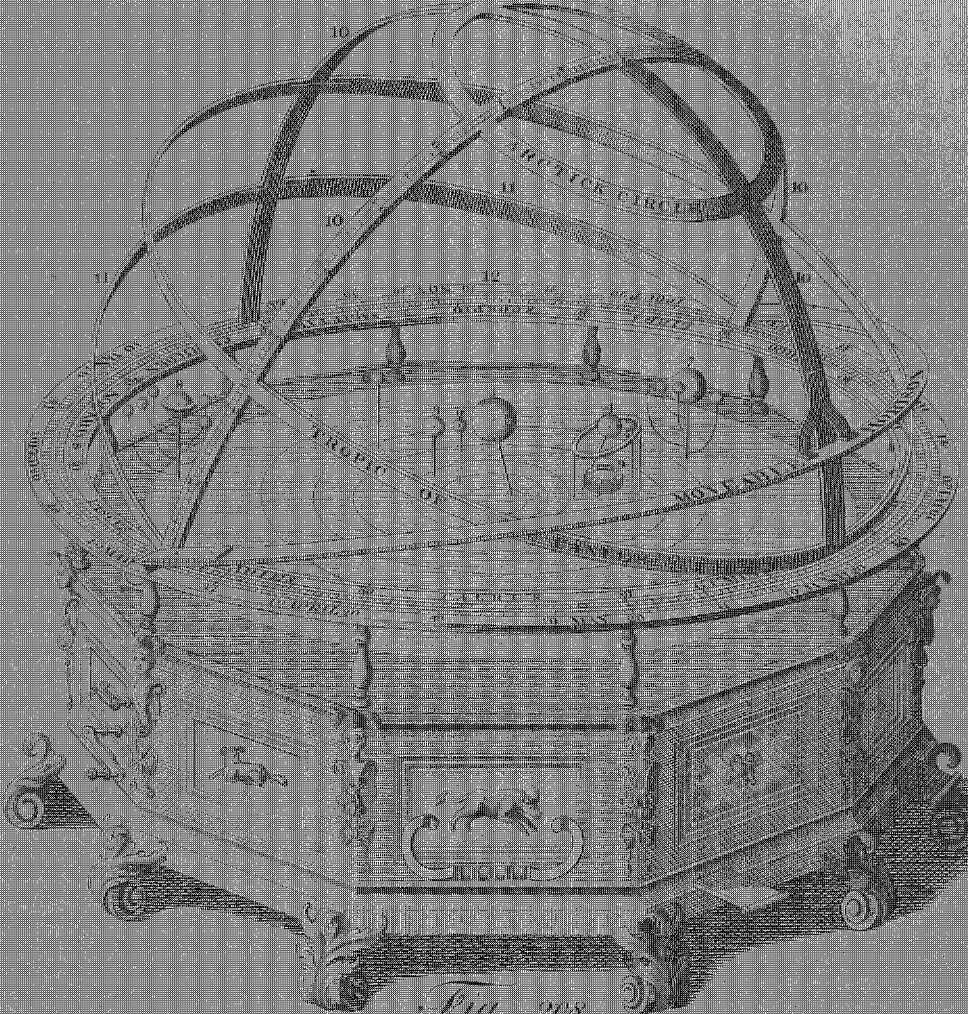

Fig. 208
FERGUSONS ORRERY

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You see by this planetarium that the motions of the planets should always be regular and uniformly the same; whereas on the contrary, we observe them always to move with a variable velocity, sometimes faster, then slower, and sometimes not at all, as will be presently shown. (5.) By the machine you see the planets move all the same way, viz. from west to east continually: but in the heavens we see them move sometimes direct from west to east, sometimes retrograde from east to west, and at other times to be stationary. All which phenomena plainly prove this system to be a false and absurd hypothesis.

The truth of the Copernican or Solar System of the world is hereby most clearly represented. For taking the earth from the *centre*, and placing thereon the usual large brass ball for the sun, and restoring the earth to its proper situation among the planets, then every thing will be right and agree exactly with celestial observations. For turning the winch H, (1.) You will see the planets Mercury and Venus go both before and behind the sun, or have two conjunctions. (2.) You will observe Mercury never to be more than a certain angular distance, 21°, and Venus 47°, from the sun. (3.) That the planets, especially Mars, will be sometimes much nearer to the earth than at others, and therefore must appear larger at one time than at another. (4.) You will see that the planets cannot appear at the earth to move with an uniform velocity; for when nearest they appear to move faster, and slower when most remote. (5.) You will observe the planets will appear at the earth to move sometimes directly from west to east, and then to become retrograde from east to west, and between both to be stationary or without any apparent motion at all. Which particulars all correspond exactly with observations, and fully prove the truth of this excellent system. Fig. 211. represents an apparatus to show these latter particulars more evidently. An hollow wire, with a slit at top, is placed over the arm of the planet Mercury or Venus at E. The arm DG represents a ray of light coming from the planet at D to the earth, and is put over the centre which carries the earth at F. The planets being then put in motion, the planet D, as seen in the heavens from the earth at F, will undergo the several changes of position as above described. The wire prop that is over Mercury at E, may be placed over the other superior planets, Mars, &c. and the same phenomena may be exhibited.

By this machine you at *once* see all the planets in motion about the sun, with the same respective velocities and periods of revolution which they have in the heavens; the wheel-work being calculated to a minute of time, from the latest discoveries.

You will see here a demonstration of the earth's motion about the sun, as well as those of the rest of the planets: for if the earth were to be at rest in the heavens, then the time between any two conjunctions of the same kind, or oppositions, would be the same with the periodical time of the planets, viz. 88 days in Mercury, 225 in Venus, &c.: whereas you here observe this time, instead of being 225 days, is no less than 583 days in Venus, occasioned by the earth's moving in the mean time about the sun the same way with the planet. And this space of 583 days always passes between two like conjunctions of Venus in the heavens. Hence the most important point of astronomy is satisfactorily demonstrated.

The diurnal rotation of the earth about its axis, and a demonstration of the cause of the different seasons of the year, and the different lengths of days and nights, are here answered completely: for as the earth is placed on an axis inclining to that of the ecliptic in an angle of 23½ degrees, and is set in motion by the wheel-work, there will be evidently seen the different inclination of the sun's rays on the earth, the different quantity thereof which falls on a given space, the different quantity of the atmosphere they pass through, and the different continuance of the sun above the horizon at the same place in different times of the year; which particulars constitute the difference betwixt heat and cold in the summer and winter seasons.

As the globe of the earth is moveable about its inclined axis, so by having the horizon of London drawn upon the surface of it, and by means of the terminating wire going over it, by which is denoted, that on that side of the wire next the sun is the enlightened half of the earth, and the opposite side the darkened half, you will here see very naturally represented the cause of the different lengths of day and night, by observing the unequal portions of the circle which the island of Great-Britain, or the city of London, or any other place, describes in the light and dark hemispheres at different times of the year, by turning the earth on its axis with the hand. But in some of the better orreries on this principle, the earth revolves about its axis by wheel-work.

As to the eclipses of the sun and moon, the true causes of them are here very clearly seen: for by placing the lamp (fig. 212,) upon the centre, in room of the brass ball denoting the sun, and turning the winch until the moon comes into a right line betwen the centers of the lamp (or sun) and earth, the shadow of the moon will fall upon the earth, and all who live on that part over which the shadow passes will see the sun eclipsed more or less. On the other side, the moon passes (in the aforesaid case) through the shadow of the earth, and is by that means eclipsed. And the orbit A (fig. 210.) is so moveable on the two joints called nodes, that any person may easily represent the due position of the modes and intermediate spaces of the moon's orbit; and thence show when there will or will not be an eclipse of either luminary, and what the quantity of each will be.

While the moon is continuing to move round the earth, the lamp on the centre will so illumine the moon, that you will easily see all the phases, as new, dichotomized, gibbous, full, waining, &c. just as they appear in the heavens. You will moreover observe all the same phases of the earth as they appear at the moon.

The satellites of Jupiter and Saturn are moveable only by the hand; yet may all their phenomena be easily represented, excepting the true relative motions and distances. Thus, if that gilt globe which before represented the sun be made now to denote Jupiter, and four of the primary planets only be retained, then will the Jovian system be represented; and by candle light only you will see (the machine being in motion) the immersions and emersions of the satellites into and out of Jupiter's shadow. You will see plainly the manner in which they transit his body, and their occultations

Aſtronomical Machinery.

cultations behind it. You will obſerve the various ways in which one or more of theſe moons may at times diſappear. And if the machine be ſet by a white wall, &c. then by the projection of their ſhadows will be ſeen the reaſons why thoſe moons always appear on each ſide of Jupiter in a right line, why thoſe which are moſt remote may appear neareſt, and *è contrario*. And the ſame may be done for Saturn's five moons and his ring.

490 *The Method of Rectifying the Orrery, and the proper Manner of placing the Planets in their true Situations.*

Having dwelled thus much on the deſcription of orreries, it may be uſeful to young readers, to point out the method by which the orrery ſhould be firſt rectified, previous to the exhibition or uſing of it: and the following is extracted from Mr William Jones's deſcription of his new *Portable Orrery*, " The method of ſhowing the places, and relative aſpects of the planets on any day of the year in the planetarium, muſt be done by the aſſiſtance of an *ephemeris* or *almanac*, which among other almanacs is publiſhed annually by the Stationer's Company.

" This ephemeris contains a diary or daily account of the planets places in the heavens, in ſigns, degrees, and minutes, both as they appear to the eye ſuppoſed to be at the ſun, and at the earth, throughout the year. The firſt of theſe poſitions is called the *heliocentric place*, and the latter, the *geocentric place*. The heliocentric place is that made uſe of in orreries; the geocentric place, that in globes. As an example for finding their places, and ſetting them right in the orrery, we will ſuppoſe the ephemeris (by *White*, which for this purpoſe is conſidered the beſt) at hand, wherein at the bottom of the *left-hand* page for every month is the heliocentric longitudes (or places) of all the planets to every ſix days of the month; which is near enough for common uſe: a copy of one of theſe tables for March 1784 is here inſerted for the information of the tyro.

Days	Day increaſ.	Helioc. long. ♄	Helioc. long. ♃	Helioc. long. ♂	Helioc. long. ⊖	Helioc. long. ♀	Helioc. long. ☿
1	3 11	16 ♑ 45	17 ♒ 11	1 ♋ 30	11 ♍ 37	0 ♐ 35	7 ♏ 58
7	3 35	16 56	17 43	4 23	17 37	10 7	25 23
13	3 59	17 7	18 15	7 15	23 36	19 38	11 ♐ 59
19	4 23	17 17	18 47	10 6	29 33	29 8	28 33
25	4 47	17 28	19 19	12 55	5 ♎ 30	8 ♑ 38	15 ♑ 49

Now, as an example, we will ſuppoſe, that in order to ſet the planets of the orrery, we want their heliocentric places for the 21ſt of this month. Looking into the table, we take the 19th day, which is the neareſt to the day wanted: then, accordingly we find the place of Saturn (♄) is in 17° 17′, or 17 degrees (rejecting the minutes, being in this caſe uſeleſs); of Capricornus (♑), of Jupiter (♃), in 18° of Aquarius (♒), Mars (♀) in 10° of Cancer (♋), the earth (⊖), in 29° of Virgo (♍), Venus (♀), in 29° of Sagittarius (♐), Mercury (☿) in 28° of the ſame ſign; and in the ſame manner for any other day therein ſpecified. Upon even this circumſtance depends a very pleaſing aſtronomical praxis, by which the young tyro may at any time be able to entertain himſelf in a moſt rational and agreeable manner, viz. he may in a minute or two repreſent the true appearance of the planetary ſyſtem juſt as it really is in the heavens, and for any day he pleaſes, by aſſigning to each planet its proper place in its orbit; as in the following manner: For the 19th of March, as before, the place of Saturn is in 17° of Capricornus (♑); now, laying hold of the arm of Saturn in the orrery, you place it over or againſt the 17° of Capricorn on the ecliptic circle, conſtantly placed on or ſurrounding the inſtrument: thus doing the ſame for the other planets, they will have their proper heliocentric places for that day.

" Now in this ſituation of the planets, we obſerve, that if a perſon was placed on the earth, he would ſee Venus and Jupiter in the ſame line and place of the ecliptic, conſequently in the heavens they would appear together, or in conjunction; Mercury a little to the left or eaſtward of them, and nearer to the ſun; Saturn to the right, or the weſtward, farther from the Sun; Mars directly oppoſite to Saturn; ſo that when Saturn appears in the weſt, Mars appears in the eaſt, and *vice verſa*. Several other curious and entertaining particulars as depending on the above, may be eaſily repreſented and ſhown by the learner, particularly the foregoing when the winch is turned, and all the planets ſet into their reſpective motions."

We cannot cloſe this detail on orreries more agreeably than by the following account of an inſtrument 491
of that ſort invented by Mr. James Ferguſon, to which he gives the name of a *Mechanical Paradox*, and which is actuated by means of what many, as he obſerves, even good mechanics, would be ready to pronounce impoſſible, viz. That the teeth of one wheel taking equally deep into the teeth of three others, ſhould affect them in ſuch a manner, that in turning it any way round its axis, it ſhould turn one of them the *ſame way*, another the *contrary way*, and the third *no way at all*.

The ſolution of the paradox is given under the article Mechanics; after which, our author proceeds to give the following account of its uſes. " This machine is ſo much of an orrery, as is ſufficient to ſhow the different lengths of days and nights, the viciſſitudes of the ſeaſons, the retrograde motion of the nodes of the moon's orbit, the direct motion of the apogeal point of her orbit, and the months in which the ſun and moon muſt be eclipſed.

" On the great immoveable plate A (ſee fig. 213.) are the months and days of the year, and the ſigns and degrees of the zodiac ſo placed, that when the annual index *h* is brought to any given day of the year, it will point to the degree of the ſign in which the ſun is on that day. This index is fixed to the moveable frame BC,

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BC, and is carried round the immoveable plate with it, by means of the knob *n*. The carrying this frame and index round the immoveable plate, answers to the earth's annual motion round the sun, and to the sun's apparent motion round the ecliptic in a year.

"The central wheel D (being fixt on the axis *a*, which is fixt in the centre of the immoveable plate) turns the thick wheel E round its own axis by the motion of the frame: and the teeth of the wheel E take into the teeth of the three wheels F, G, H, whose axes turn within one another, like the axes of the hour, minute, and second hands of a clock or watch, where the seconds are shown from the centre of the dial-plate.

"On the upper ends of these axes, are the round plates I, K, L; the plate I being on the axis of the wheel F, K on the axis of G, and L on the axis of H. So that which ever way these wheels are affected, their respective plates, and what they support, must be affected in the same manner; each wheel and plate being independent of the others.

"The two upright wires M and N, are fixed into the plate I; and they support the small ecliptic OP, on which, in the machine, the signs and degrees of the ecliptic are marked. This plate also supports the small terrestrial globe *e* on its inclining axis *f*, which is fixed into the plate near the foot of the wire N. This axis inclines $23\frac{1}{2}$ degrees from a right line, supposed to be perpendicular to the surface of the plate I, and also to the plane of the small ecliptic OP which is parallel to that plate.

"On the earth *e* is the crescent *g*, which goes more than half way round the earth, and stands perpendicular to the plane of the small ecliptic OP, directly facing the sun Z: Its use is to divide the enlightened half of the earth next the sun from the other half which is then in the dark; so that it represents the boundary of light and darkness, and therefore ought to go quite round the earth; but cannot in a machine, because in some positions the earth's axis would fall upon it. The earth may be freely turned round on its axis by hand, within the crescent, which is supported by the crooked wire *w*, fixt to it, and into the upper plate of the moveable frame BC.

"In the plate K are fixed the two upright wires Q and R: they support the moon's inclined orbit ST in its nodes, which are the two opposite points of the moon's orbit where it intersects the ecliptic OP. The ascending node is marked ☊, to which the descending node is opposite below *e*, but hid from view by the globe *e*. The half ☊ T *e* of this orbit is on the north-side of the ecliptic OP, and the other half *e* S ☊ is on the south side of the ecliptic. The moon is not in this machine; but when she is in either of the nodes of her orbit in the heavens, she is then in the plane of the ecliptic: when she is in T in her orbit, she is in her greatest north latitude; and when she is at S, she is in her greatest south latitude.

"In the plate L is fixed the crooked wire UU, which points downward to the small ecliptic OP, and shows the motion of the moon's apogee therein, and its place at any given time.

"The ball Z represents the sun, which is supported by the crooked wire XY, fixt into the upper plate of the frame at X. A straight wire W proceeds from the sun Z, and points always toward the centre of the earth *e*; but toward different points of its surface at different times of the year, on account of the obliquity of its axis, which keeps its parallelism during the earth's annual course round the sun Z; and therefore must incline sometimes toward the sun, at other times from him, and twice in the year neither toward nor from the sun, but sidewise to him. The wire W is called *the solar ray*.

"As the annual-index *h* shows the sun's place in the ecliptic for every day of the year, by turning the frame round the axis of the immoveable plate A, according to the order of the months and signs, the solar ray does the same in the small ecliptic OP: for as this ecliptic has no motion on its axis, its signs and degrees still keep parallel to those on the immoveable plate. At the same time, the nodes of the moon's orbit ST (or points where it intersects the ecliptic OP) are moved backward, or contrary to the order of signs, at the rate of $19\frac{1}{3}$ degrees every Julian year; and the moon's apogeal wire UU is moved forward, or according to the order of the signs of the ecliptic, nearly at the rate of 41 degrees every Julian year; the year being denoted by a revolution of the earth *e* round the sun Z; in which time the annual-index *h* goes round the circles of months and signs on the immoveable plate A.

"Take hold of the knob *n*, and turn the frame round thereby; and in doing this, you will perceive that the north pole of the earth *e* is constantly before the crescent *g*, in the enlightened part of the earth toward the sun, from the 20th of March to the 23d of September; and the south pole all that time behind the crescent in the dark; and from the 23d of September to the 20th of March, the north pole is constantly in the dark behind the crescent, and the south pole in the light before it; which shows, that there is but one day and one night at each pole, in the whole year; and that when it is day at either pole, it is night at the other.

"From the 20th of March to the 23d of September, the days are longer than the nights in all those places of the northern hemisphere of the earth which revolve through the light and dark, and shorter in those of the southern hemisphere. From the 23d of September to the 20th of March the reverse.

"There are 24 meridian semicircles drawn on the globe, all meeting in its poles; and as one rotation or turn of the earth on its axis is performed in 24 hours, each of these meridians is an hour distant from the other, in every parallel of latitude. Therefore, if you bring the annual-index *h* to any given day of the year, on the immoveable plate, you may see how long the day then is at any place of the earth, by counting how many of these meridians are in the light, or before the crescent, in the parallel of latitude of that place; and this number being subtracted from 24 hours, will leave remaining the length of the night. And if you turn the earth round its axis, all those places will pass directly under the point of the solar ray, which the sun passes vertically over on that day, because they are just as many degrees north or south of the equator as the sun's declination is then from the equinoctial.

"At the two equinoxes, viz. on the 20th of March and 23d of September, the sun is in the equinoctial, and

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and consequently has no declination. On these days, the solar ray points directly toward the equator, the earth's poles lie under the inner edge of the crescent, or boundary of light and darkness; and in every parallel of latitude there are 12 of the meridians or hour circles before the crescent, and 12 behind it; which shows that the days and nights then are each 12 hours long at all places of the earth. And if the earth be turned round its axis, you will see that all places on it go equally through the light and the dark hemispheres.

"On the 21st of of June, the whole space within the north polar circle is enlightened, which is $23\frac{1}{2}$ degrees from the pole, all around; because the earth's axis then inclines $23\frac{1}{2}$ degrees toward the sun: but the whole space within the south polar circle is in the dark; and the solar ray points toward the tropic of Cancer on the earth, which is $23\frac{1}{2}$ degrees north from the equator. On the 20th of December the reverse happens, and the solar ray points toward the tropic of Capricorn, which is $23\frac{1}{2}$ degrees south from the equator.

"If you bring the annual-index *h* to the beginning of January, and turn the moon's orbit ST by its supporting wires Q and R till the ascending node (marked ☊) comes to its place in the ecliptic OP, as found by an ephemeris, or by astronomical tables, for the beginning of any given year; and then move the annual-index by means of the knob *n*, till the index comes to any given day of the year afterward, the nodes will stand against their places in the ecliptic on that day; and if you move on the index till either of the nodes comes directly against the point of the solar ray, the index will then be at the day of the year on which the sun is in the conjunction with that node. At the times of those new moons which happen within seventeen days of the conjunction of the sun with either of the nodes, the sun will be eclipsed: and at the times of those full moons, which happen within twelve days of either of these conjunctions, the moon will be eclipsed. Without these limits there can be no eclipses either of the sun or moon; because, in nature, the moon's latitude or declination from the ecliptic is too great for the moon's shadow to fall on any part of the earth, or for the earth's shadow to touch the moon.

"Bring the annual-index to the beginning of January, and set the moon's apogeal wire UU to its place in the ecliptic for that time, as found by astronomical tables; then move the index forward to any given day of the year, and the wire will point on the small ecliptic to the place of the moon's apogee for that time.

"The earth's axis *f* inclines always toward the beginning of the sign Cancer on the small ecliptic OP. And if you set either of the moon's nodes, and her apogeal wire to the beginning of that sign, and turn the plate A about, until the earth's axis inclines toward any side of the room (suppose the north side), and then move the annual-index round and round the immoveable plate A, according to the order of the months and signs upon it, you will see that the earth's axis and beginning of Cancer will still keep toward the same side of the room, without the least deviation from it; but the nodes of the moon's orbit ST will turn progressively towards all the sides of the room, contrary to the order of signs in the small ecliptic OP, or from east, by south, to west, and so on; and the apogeal wire UU, will turn the contrary way to the motion of the nodes, or according to the order of the signs in the small ecliptic, from west, by south, to east, and so on quite round. A clear proof that the wheel F, which governs the earth's axis and the small ecliptic, does not turn any way round its own centre; that the wheel G, which governs the moon's orbit OP, turns round its own centre backward, or contrary both to the motion of the frame BC and thick wheel E; and that the wheel H, which governs the moon's apogeal wire UU, turns round its own centre forward, or in direction both of the motion of the frame and of the thick wheel E, by which the three wheels F, G, and H, are affected.

The wheels D, E, and F, have each 39 teeth in the machine; the wheel G has 37, and H 44.

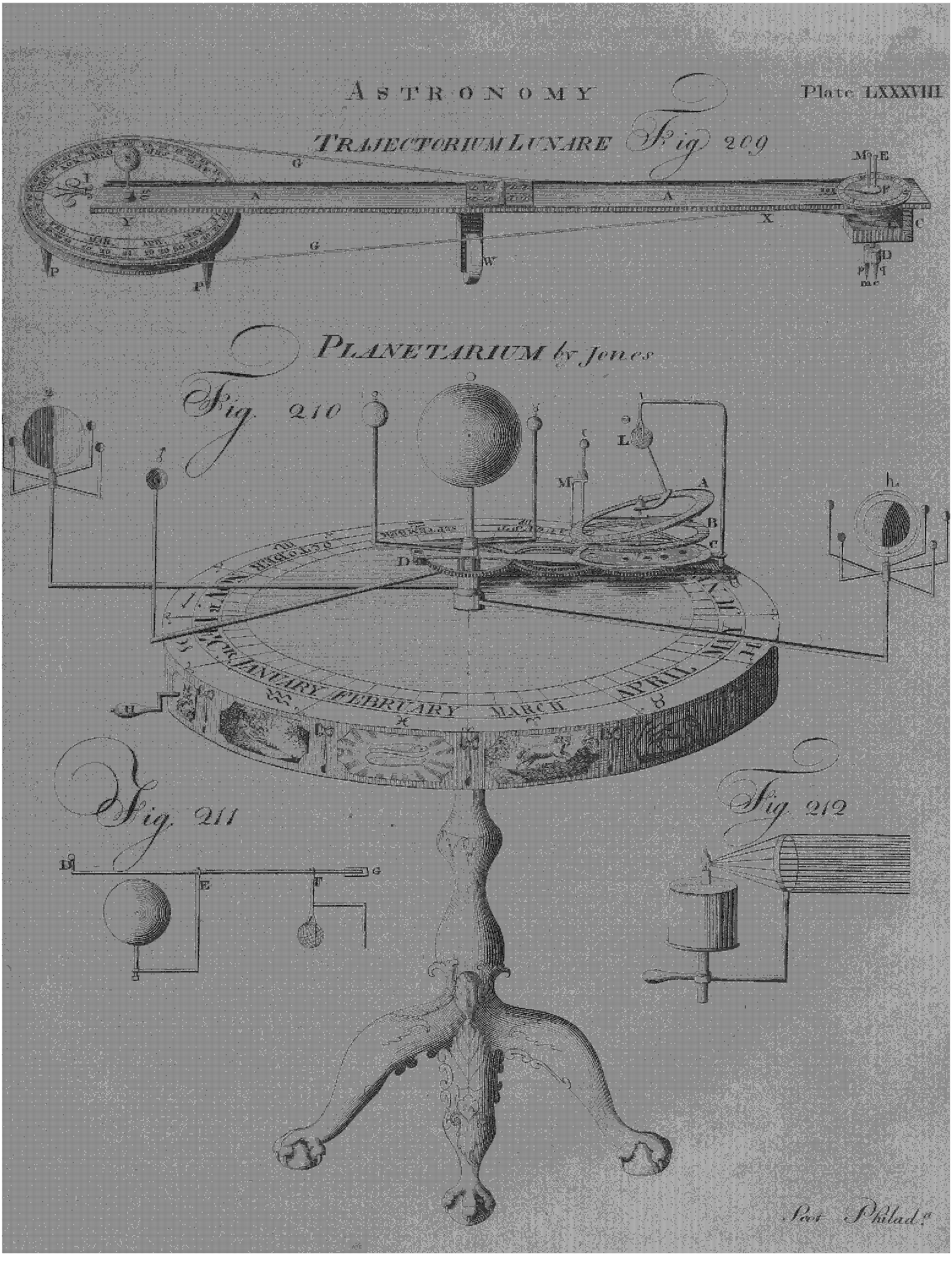
"The parallelism of the earth's axis is perfect in this machine; the motion of the apogee very nearly so; the motion of the nodes not quite so near the truth, though they will not vary sensibly therefrom in one year. But they cannot be brought nearer, unless larger wheels, with higher numbers of teeth, are used.

In nature, the moon's apogee goes quite round the ecliptic in eight years and 312 days, in direction of the earth's annual motion; and the nodes go round the ecliptic, in a contrary direction, in 18 years and 225 days. In the machine, the apogee goes round the ecliptic OP in eight years and four-fifths of a year, and the nodes in eighteen years and a half."

The Cometarium, (fig. 216.) This curious machine shows the motion of a comet or eccentric body moving round the sun, describing equal areas in equal times, and may be so contrived as to show such a motion for any degree of eccentricity. It was invented by the late Dr Desaguliers. 402

The dark elliptical groove round the letters *a b c d e f g h i k l m* is the orbit of the comet Y; this comet is carried round in the groove according to the order of letters, by the wire W fixed in the sun S, and slides on the wire as it approaches nearer to or recedes farther from the sun, being nearest of all in the perihelion *a*, and farthest in the aphelion *g*. The areas, *a* S *b*, *b* S *c*, *c* S *d*, &c. or contents of these several triangles, are all equal; and in every turn of the winch N, the comet Y is carried over one of these areas; consequently, in as much time as it moves from *f* to *g*, or from *g* to *h*, it moves from *m* to *a*, or from *a* to *b*; and so of the rest, being quickest of all at *a*, and slowest at *g*. Thus the comet's velocity in its orbit continually decreases from the perihelion *a* to the aphelion *g*; and increases in the same proportion from *g* to *a*.

The elliptic orbit is divided into 12 equal parts or signs, with their respective degrees, and so is the circle *n o p q r s t u*, which represents a great circle in the heavens, and to which the comet's motion is referred by a small knob on the point of the wire W. Whilst the comet moves from *f* to *g* in its orbit, it appears to move only about five degrees in this circle, as is shown by the small knob on the end of the wire W; but in as short time as the comet moves from *m* to *a*, or from *a* to *b*, it appears to describe the large space *t n* or *n o* in the heavens, either of which spaces contains


ASTRONOMY
Plate LXXXVIII
TRAJECTORIUM LUNARE Fig. 209
PLANETARIUM by Jones
Fig. 210
JANUARY FEBRUARY MARCH APRIL
Fig. 211
Fig. 212
Scot Philad.

Astronomical Machinery.

tains 120 degrees, or four signs. Were the eccentricity of its orbit greater, the greater still would be the difference of its motion, and *vice versa*.

ABCDEFGHIKLM is a circular orbit for showing the equable motion of a body round the sun S, describing equal areas ASB, BSC, &c. in equal times with those of the body Y in its elliptical orbit abovementioned; but with this difference, that the circular motion describes the equal arcs AB, BC, &c. in the same equal times that the elliptical motion describes the unequal arcs, *a b*, *bc*, &c.

Now, suppose the two bodies Y and 1 to start from the points *a* and A at the same moment of time, and, each having gone round its respective orbit, to arrive at these points again at the same instant, the body Y will be forwarder in its orbit than the body 1 all the way from *a* to *g*, and from A to G: but 1 will be forwarder than Y through all the other half of the orbit; and the difference is equal to the equation of the body Y in its orbit. At the points *a* A, and *g* G, that is, that in the perihelion and aphelion they will be equal; and then the equation vanishes. This shows why the equation of a body moving in an elliptic orbit, is added to the mean or supposed circular motion from the perihelion to the aphelion, and subtracted from the aphelion to the perihelion, in bodies moving round the sun, or from the perigee to the apogee, and from the apogee to the perigee in the moon's motion round the earth.

This motion is performed in the following manner by the machine, fig. 217. ABC is a wooden bar (in the box containing the wheel-work), above which are the wheels D and E, and below it the elliptic plates FF and GG; each plate being fixed on an axis in one of its focuses, at E and K: and the wheel E is fixed on the same axis with the plate FF. These plates have grooves round their edges precisely of equal diameters to one another, and in these grooves is the cat-gut string *g g*, *g g* crossing between the plates at *h*. On H, the axis of the handle or winch N in fig. 216, is an endless screw in fig. 217. working in the wheels D and E, whose numbers of teeth being equal, and should be equal to the number of lines *a* S, *b* S, *c* S, &c. in fig. 216, they turn round their axes in equal times to one another, and to the motion of the elliptic plates. For, the wheels D and E having equal numbers of teeth, the plate FF being fixed on the same axis with the wheel E, and turning the equally big plate GG by a cat-gut string round them both, they must all go round their axes in as many turns of the handle N as either of the wheels has teeth.

It is easy to see, that the end of *h* of the elliptical plate FF being farther from its axis E than the opposite end I is, must describe a circle so much the larger in proportion, and therefore move through so much more space in the same time; and for that reason the end *h* moves so much faster than the end I, although it goes no sooner round the centre E. But then the quick-moving end *h* of the plate FF leads about the short end *h* K of the plate GG with the same velocity; and the slow-moving end I of the plate FF coming half round as to B, must then lead the long end *k* of the plate GG as slowly about: so that the elliptical plate FF and its axis E move uniformly and equally quick in every part of its revolution; but the elliptical plate GG, together with its axis K, must move very unequally in different parts of its revolution; the difference being always inversely as the distance of any point of the circumference of GG from its axis at K: or in other words, to instance in two points, if the distance K *k* be four, five, or six times as great as the distance K *h*, the point *h* will move in that position, four, five, or six times as fast as the point *k* does, when the plate GG has gone half round; and so on for any other eccentricity or difference of the distances K *k* and K *h*. The tooth I on the plate FF falls in between the two teeth at *k* on the plate GG; by which means the revolution of the latter is so adjusted to that of the former, that they can never vary from one another.

On the top of the axis of the equally moving-wheel D in fig. 217. is the sun S in fig. 216.; which sun, by the wire fixed to it, carries the ball 1 round the circle ABCD, &c. with an equable motion, according to the order of the letters: and on the top of the axis K of the unequally-moving ellipsis GG, in fig. 217. is the sun S in fig. 216. carrying the ball Y unequally round in the elliptical groove *a b c d*, &c. *N. B.* This elliptical groove must be precisely equal and similar to the verge of the plate GG, which is also equal to that of FF.

In this manner machines may be made to show the true motion of the moon about the earth, or of any planet about the sun, by making the elliptical plates of the same eccentricities, in proportion to the radius, as the orbits of the planets are, whose motions they represent; and so their different equations in different parts of their orbits may be made plain to sight, and clearer ideas of these motions and equations acquired in half an hour, than could be gained from reading half a day about such motions and equations.

The Improved Celestial Globe, fig. 187. On the north pole of the axis, above the hour-circle, is fixed an arch MKH of $23\frac{1}{2}$ degrees; and at the end H is fixed an upright pin HG, which stands directly over the north pole of the ecliptic, and perpendicular to that part of the surface of the globe. On this pin are two moveable collets at D and H, to which are fixed the quadrantile wires N and O, having two little balls on their ends for the sun and moon, as in the figure. The collet D is fixed to the circular plate F, whereon the $29\frac{1}{2}$ days of the moon's age are engraven, beginning just under the sun's wire N; and as this wire is moved round the globe, the plate F turns round with it. These wires are easily turned, if the screw G be slackened: and when they are set to their proper places, the screw serves to fix them there, so as in turning the ball of the globe, the wires with the sun and moon go round with it; and these two little balls rise and set at the same times, and on the same points of the horizon, for the day to which they are rectified, as the soon and moon do in the heavens. 493

Because the moon keeps not her course in the ecliptic (as the sun appears to do), but has a declination of $5\frac{1}{3}$ degrees on each side from it in every lunation, her ball may be screwed as many degrees to either side of the ecliptic as her latitude or declination from the ecliptic amounts to at any given time.

The horizon is supported by two semicircular arches, because pillars would stop the progress of the balls

Astronomical Machinery.

balls when they go below the horizon in an oblique sphere.

To rectify this globe. Elevate the pole to the latitude of the place; then bring the sun's place in the ecliptic for the given day to the brazen meridian, and set the hour-index to 12 at noon, that is, to the upper 12 on the hour-circle; keeping the globe in that situation, slacken the screw G, and set the sun directly over his place on the meridian; which done set the moon's wire under the number that expresses her age for that day on the plate F, and she will then stand over her place in the ecliptic, and show what constellation she is in. Lastly, fasten the screw G, and adjust the moon to her latitude, and the globe will be rectified.

Having thus rectified the globe, turn it round, and observe on what points of the horizon the sun and moon balls rise and set, for these agree with the points of the compass on which the sun and moon rise and set in the heavens on the given day: and the hour-index shows the times of their rising and setting; and likewise the time of the moon's passing over the meridian.

This simple apparatus shows all the varieties that can happen in the rising and setting of the sun and moon: and makes the forementioned phenomena of the harvest moon plain to the eye. It is also very useful in reading lectures on the globes, because a large company can see this sun and moon go round, rising above and setting below the horizon at different times, according to the seasons of the year; and making their appulses to different fixed stars. But in the usual way, where there is only the places of the sun and moon in the ecliptic to keep the eye upon, they are easily lost sight of, unless they be covered with patches.

494 The Trajectorium Lunare, fig. 208. This machine is for delineating the paths of the earth and moon, showing what sort of curves they make in the etherial regions. S is the sun, and E the earth, whose centres are 95 inches distant from each other; every inch answering to 1,000,000 of miles. M is the moon, whose centre is $\frac{24}{100}$ parts of an inch from the earth's in this machine, this being in just proportion to the moon's distance from the earth. AA is a bar of wood, to be moved by hand round the axis g which is fixed in the wheel Y. The circumference of this wheel is to the circumference of the small wheel L (below the other end of the bar) as 365¼ days is to 29½, or as a year is to a lunation. The wheels are grooved round their edges, and in the grooves is the cat-gut string GG crossing between the wheels at X. On the axis of the wheel L is the index F, in which is fixed the moon's axis M for carrying her round the earth E (fixed on the axis of the wheel L in the time that the index goes round a circle of 29½ equal parts, which are the days of the moon's age. The wheel Y has the months and days of the year all round its limb; and in the bar AA is fixed the index l, which points out the days of the months answering to the days of the moon's age, shown by the index F, in the circle of 29½ equal parts at the other end of the bar. On the axis of the wheel L is put the piece D, below the cock C, in which this axis turns round; and in D are put the pencils e and m directly under the earth E and moon M; so that m is carried round e as M is round E

Lay the machine on an even floor, pressing gently on the wheel Y, to cause its spiked feet (of which two appear at P and P, the third being supposed to be hid from sight by the wheel) enter a little into the floor to secure the wheel from turning. Then lay a paper about four feet long under the pencils e and m, crosswise to the bar; which done, move the bar slowly round the axis g of the wheel Y; and as the earth E goes round the sun S, the moon M will go round the earth with a duly proportioned velocity; and the friction wheel W running on the floor, will keep the bar from bearing too heavily on the pencils e and m, which will delineate the paths of the earth and moon. As the index I points out the days of the months, the index F shows the moon's age on these days, in the circle of 29½ equal parts. And as this last index points to the different days in its circle, the like numeral figures may be set to those parts of the curves of the earth's path and moon's, where the pencils e and m are at those times respectively, to show the places of the earth and moon. If the pencil e be pushed a very little off, as if from the pencil m, to about $\frac{1}{40}$ part of their distance, and the pencil m pushed as much towards e, to bring them to the same distances again, though not to the same points of space; then, as m goes round e, e will go as it were round the centre of gravity between the earth e and moon m; but this motion will not sensibly alter the figure of the earth's path or the moon's.

If a pin, as p, be put through the pencil m, with its head, towards that of the pin q in the pencil e, its head will always keep thereto as m goes round e, or as the same side of the moon is still obverted to the earth. But the pin p, which may be considered as an equatorial diameter of the moon, will turn quite round the point m, making all possible angles with the line of its progress, or line of the moon's path. This is an occular proof of the moon's turning round her axis.

Sect. XIII. *A Description of the principal astronomical Instruments by which Astronomers make their most accurate Observations.*

By practical astronomy is implied the knowledge of observing the celestial bodies with respect to their position and time of the year, and of deducing from those observations certain conclusions useful in calculating the time when any proposed position of these bodies shall happen. 495

For this purpose, it is necessary to have a room or place conveniently situated, suitably contrived, and furnished with proper astronomical instruments. It should have an uninterrupted view from the zenith down to (or even below) the horizon, at least towards its cardinal points: and for this purpose, that part of the roof which lies in the direction of the meridian in particular, should have moveable covers, which may easily be moved and put on again; by which means an instrument may be directed to any point of the heavens between the horizon and the zenith, as well to the northward as southward.

This place, called an Observatory, should contain some, if not all, of the following instruments.

I. A Pendulum Clock, for showing equal time. 496 This

This should show time in hours, minutes, and seconds; and with which the observer, by hearing the beats of the pendulum, may count them by his ear, while his eye is employed on the motion of the celestial object he is observing. Just before the object arrives at the position described, the observer should look on the clock and remark the time, suppose it 9 hours 15 minutes 25 seconds; then saying, 25, 26, 27, 28, &c. responsive to the beat of the pendulum, till he sees through the instrument the object arrived at the position expected; which suppose to happen when he says 38, he then writes down 9 h. 15 min. 38 sec. for the time of observation, annexing the year and the day of the month. If two persons are concerned in making the observation, one may read the time audibly while the other observes through the instrument, the observer repeating the last second read when the desired position happens.

II. An Achromatic Refracting Telescope, or a Reflecting one, of two feet at least in length, for observing particular phenomena. These instruments are particularly described under Optics.

III. A Micrometer, for measuring small angular distances. See Micrometer.

IV. Astronomical Quadrants, both mural and portable, for observing meridian and other altitudes of the celestial bodies.

497 1. The *Mural Quadrant* is in the form of a quarter of a circle, contained under two radii at right angles to one another, and an arch equal to one-fourth part of the circumference of the circle. It is the most useful and valuable of all the astronomical instruments; and as it is sometimes fixed to the side of a stone or brick wall, and the plane of it erected exactly in the plane of the meridian, it in this case receives the name of *mural quadrant or arch*.

Tycho Brache was the first person who contrived this mural arch, viz. who first applied it to a wall; and Mr Flamstead, the first in England who with indefatigable pains fixed one up in the royal observatory at Greenwich.

These instruments have usually been made from five to eight feet radius, and executed by those late celebrated artists, Sisson, Graham, Bird, and other eminent mathematical instrument makers now in London. The construction of them being generally the same in all the sizes, we shall here describe one made by the late Jon. Sisson, under the direction of the late M. Graham. Fig. 214. represents the instrument as already fixed to the wall. It is of copper, and of about 5 feet radius. The frame is formed of flat bars, and strengthened by edge bars affixed underneath perpendicularly to them. The radii HB, HA, being divided each into four equal parts, serve to find out the points D and E, by which the quadrant is freely suspended on its props or iron supports that are fastened securely in the wall.

One of the supports E is represented separately in *e* on one side of the quadrant. It is moveable by means of a long slender rod EF or *ef*, which goes into a hollow screw in order to restore the instrument to its situation when it is discovered to be a little deranged. This may be known by the very fine perpendicular thread HA, which ought always to coincide with the same point A of the limb, and carefully examined to be so by a small magnifying telescope at every observation. In order to prevent the unsteadiness of so great a machine, there should be placed behind the limb four copper ears with double cocks I, K, I, K. There are others along the radii HA and HB. Each of these cocks contains two screws, into which is fastened the ears that are fixed behind the quadrant.

Over the wall or stone which supports the instrument, and at the same height as the centre is placed horizontally the axis PO, which is perpendicular to the plane of the instrument, and which would pass through the centre if it was continued. This axis turns on two pivots P. On this axis is fixed at right angles another branch ON, loaded at its extremity with a weight N capable of equipoising with its weight that of the telescope LM; whilst the axis, by its extremity nearest the quadrant, carries the wooden frame PRM, which is fastened to the telescope in M. The counterpoise takes off from the observer the weight of the telescope when he raises it, and hinders him from either forcing or straining the instrument.

The lower extremity (V) of the telescope is furnished with two small wheels, which take the limb of the quadrant on its two sides. The telescope hardly bears any more upon the limb than the small friction of these two wheels; which renders its motion so extremely easy and pleasant, that by giving it with the hand only a small motion, the telescope will run of itself over a great part of the limb, balanced by the counterpoise N.

When the telescope is to be stopped at a certain position, the copper hand T is to be made use of, which embraces the limb and springs at the bottom. It is fixed by setting a screw, which fastens it to the limb. Then, in turning the regulating screw, the telescope will be advanced; which is continued until the star or other object whose altitude is observing to be on the horizontal fine thread in the telescope. Then on the plate X supporting the telescope, and carrying a vernier or nonius, will be seen the number of degrees and minutes, and even quarter of minutes, that the angular height of the object observed is equal to. The remainder is easily estimated within two or three seconds nearly.

There are several methods of subdividing the divisions of a mural quadrant, which are usually from five to ten minutes each; but that which is most commonly adopted is by the vernier or nonius, the contrivance of Peter Vernier a Frenchman. This vernier consists of a piece of copper or brass, CDAB (fig. 215.), which is a small portion of X (fig. 214.), represented separately. The length CD is divided into 20 equal parts, and placed contiguously on a portion of the division of the limb of the quadrant containing 21 divisions, and thereby dividing this length into 20 equal parts. Thus the first division of the vernier piece marked 15, beginning at the point D, is a little matter backward, or to the left of the first division of the limb, equal to 15″. The second division of the vernier is to the left of the second division of the limb double of the first difference, or 30″; and so on unto the twentieth and last division on the left of the vernier piece; where the 20 differences being accumulated each of the twentieth part of the division of the limb, this last division will

 be

be found to agree exactly with the 21st division on the limb of the quadrant.

The index must be pushed the 20th part of a division, or 15″, to the right; for to make the second division on the vernier coincide with one of the divisions of the limb, in like manner is moving two-twentieths, or 30″, we must look at the second division of the index, and there will be a coincidence with a division of the limb. Thus may be conceived that the beginning D of the Vernier, which is always the line of reckoning, has advanced two divisions, or 30″, to the right, when the second division, marked 30 on the vernier, is seen to correspond exactly with one of the lines of the quadrant.

By means of this vernier may be readily distinguished the exactitude of 15″ of the limb of a quadrant five feet radius, and simply divided into 5′. By an estimation by the eye, afterwards the accuracy of two or three seconds may be easily judged. On the side of the quadrant is placed the plate of copper which carries the telescope. This plate carries two verniers. The outer line CD divides five minutes into 20 parts, or 15″ each. The interior line AB answers to the parts of another division not having 90°, but 96 parts of the quadrant. It is usually adopted by English astronomers on account of the facility of its subdivisions. Each of the 96 portions of the quadrant is equivalent to 56′ 15″ of the usual divisions. It is divided on the limb into 16 parts, and the arch of the vernier AB contains 25 of these divisions; and being divided itself into 24, immediately gives parts, the value of each of which is 8″ 47½‴. From this mode a table of reduction may easily be constructed, which will serve to find the value of this second mode of dividing in degrees, minutes, and seconds, reckoning in the usual manner, and to have even the advantage of two different modes; which makes an excellent verification of the divisions on the limb of the quadrant and observed heights by the vernier.

498 2. *The Portable Astronomical Quadrant*, is that instrument of all others which astronomers make the greatest use of, and have the most esteem for. They are generally made from 12 to 23 inches. Fig. 219. is a representation of the improved modern one as made by the late Mr Sisson and by the present mathematical instrument makers. This is capable of being carried to any part of the world, and put up for observation in an easy and accurate manner. It is made of brass, and strongly framed together by crossed perpendicular bars. The arch AC, and the telescope EF, are divided and constructed in a similar manner to the mural quadrant, but generally without the division of 96 parts. The counterpoise to the telescope T is represented at P, and also another counterpoise to the quadrant itself at P. The quadrant is fixed to a long axis, which goes into the pillar KR. Upon this axis is fixed an index, which points to, and subdivides by a vernier the divisions of the azimuth circle K. This azimuth circle is extremely useful for taking the azimuth of a celestial body at the same time its altitude is observed. The upper end of the axis is firmly connected with the adjusting frame GH; and the pillar is supported on the crossed feet at the bottom of the pillar KR with the adjusting screws *a*, *b*, *c*, *d*.

When this instrument is set up for use or observation, it is necessary that two adjustments be very accurately made: One, that the plane or surface of the instrument be truly perpendicular to the horizon; the other that the line supposed to be drawn from the centre to the first line of the limb, be truly on a level or parallel with the horizon. The first of these particulars is done by means of the thread and plummet *p*; the thread of which is usually of very fine silver wire, and it is placed opposite to a mark made upon the end of the limb of the instrument. The four screws at the foot, *a*, *b*, *c*, *d*, are to be turned until a perfect coincidence is observed of the thread upon the mark, which is accurately observed by means of a small telescope T, that fits on the limb. The other adjustment is effected by means of the spirit-level L, which applies on the frame GH, and the small screws turned as before until the bubble of air in the level settles in the middle of the tube. The dotted tube EB is a kind of prover to the instrument; for by observing at what mark the centre of it appears against, or by putting up a mark against it, it will at any time discover if the instrument has been displaced. The screw S at the index, is the regulating or adjusting screw, to move the telescope and index, during the observation, with the utmost nicety.

V. ASTRONOMICAL *or* EQUATORIAL SECTOR. 499
This is an instrument for finding the difference in right ascension and declination between two objects, the distance of which is too great to be observed by the micrometer. It was the invention of the late ingenious Mr George Graham, F. R. S. and is constructed from the following particulars. Let AB (fig. 32.) represent an arch of a circle containing 10 or 12 degrees well divided, having a strong plate CD for its radius, fixed to the middle of the arch at D: let this radius be applied to the side of an axis H F I, and be moveable about a joint fixed to it at F, so that the plane of the sector may be always parallel to the axis HI; which being parallel to the axis of the earth, the plane of the sector will always be parallel to the plane of some hour-circle. Let a telescope CE be moveable about the centre C of the arch AB, from one end of it to the other, by turning a screw at G; and let the line of sight be parallel to the plane of the sector. Now, by turning the whole instrument about the axis HI, till the plane of it be successively directed, first to one of the stars and then to another, it is easy to move the sector about the joint F, into such a position, that the arch AB, when fixed, shall take in both the stars in their passage, by the plane of it, provided the difference of the declinations does not exceed the arch AB. Then, having fixed the plane of the sector a little to the westward of both the stars, move the telescope CE by the screw G; and observe by a clock the time of each transit over the cross hairs, and also the degrees and minutes upon the arch AB, cut by the index at each transit; then in the difference of the arches the difference of the declinations, and by the difference of the times, we have the difference of the right ascensions of the stars.

The dimensions of this instrument are these: The length of the telescope, or the radius of the sector, is 2½ feet; the breadth of the radius, near the end C, is 1¼ inch; and at the end D two inches. The breadth of the limb AB is 1½ inch; and its length six

Fig. 213.
Mechanical Paradox.

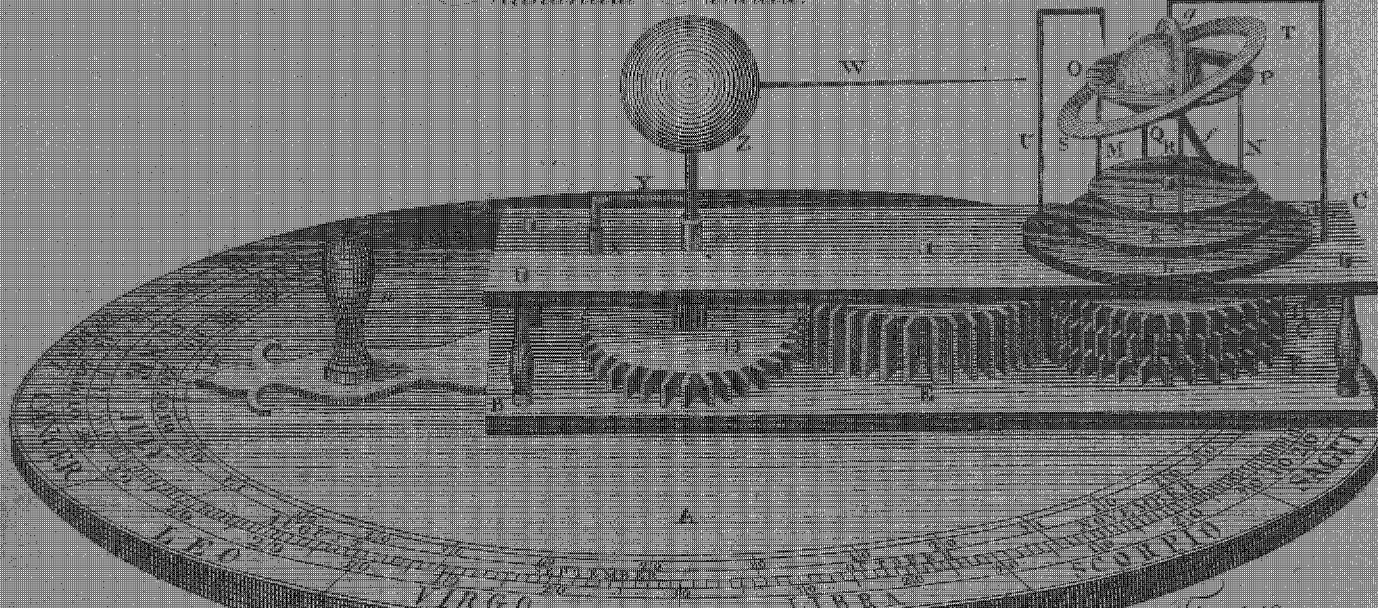


Fig. 218.

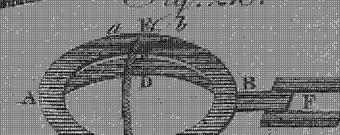


Fig. 214.
Mural Quadrant.

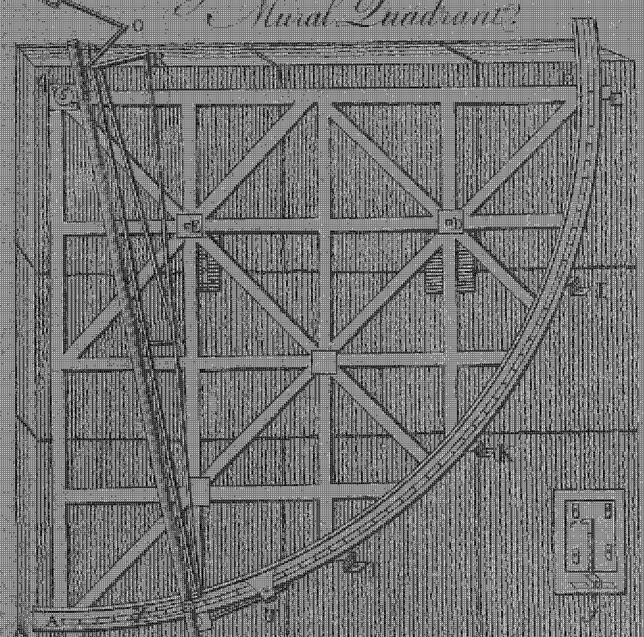


Fig. 216.
Cometarium.

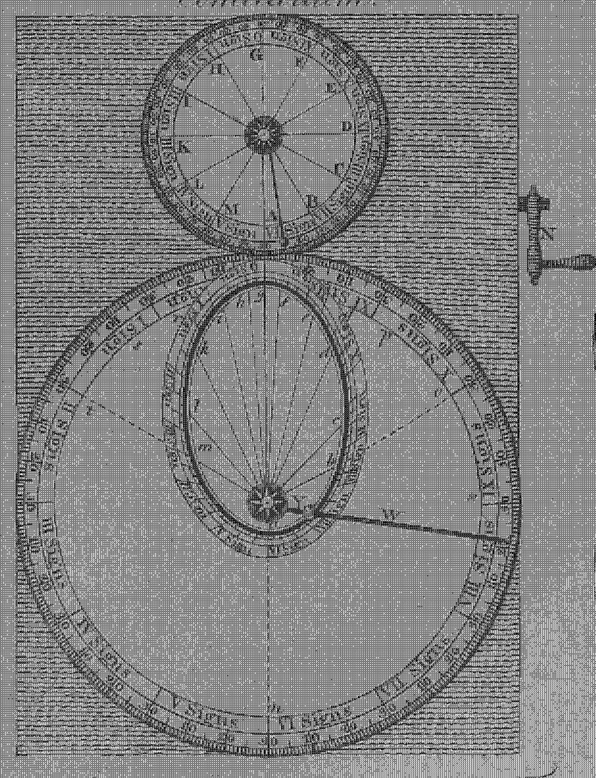


Fig. 217.

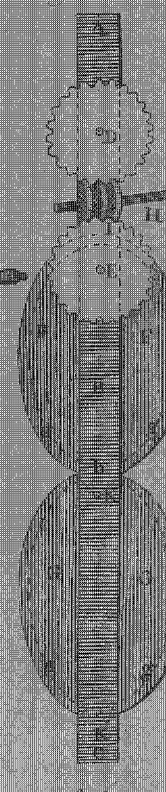
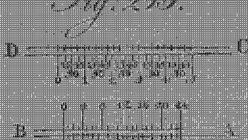


Fig. 215.



Thackara & Vallance sculp.

six inches, containing ten degrees divided into quarters and numbered from either end to the other. The telescope carries a nonius or subdividing plate, whose length, being equal to sixteen quarters of a degree, is divided into fifteen equal parts; which, in effect, divides the limb into minutes, and, by estimation, into smaller parts. The length of the square axis HIF is eighteen inches, and of the part HI twelve inches; and its thickness is about a quarter of an inch: the diameters of the circles are each five inches: the thickness of the plates, and the other measures, may be taken at the direction of a workman.

This instrument may be rectified, for making observations, in this manner: By placing the intersection of the cross hairs at the same distance from the plane of the sector, as the centre of the object-glass, the plane described by the line of sight during the circular motion of the telescope upon the limb, will be sufficiently true, or free from conical curvity; which may be examined by suspending a long plumb-line at a convenient distance from the instrument; and by fixing the plane of the sector in a vertical position, and then by observing, while the telescope is moved by the screw along the limb, whether the cross hairs appear to move along the plumb-line.

The axis *hfo* may be elevated nearly parallel to the axis of the earth, by means of a small common quadrant; and its error may be corrected, by making the line of sight follow the circular motion of any of the circumpolar stars, while the whole instrument is moved about its axis *hfo*, the telescope being fixed to the limb: for this purpose, let the telescope *kl* be directed to the star *a*, when it passes over the highest point of its diurnal circle, and let the division cut by the nonius be then noted; then, after twelve hours, when the star comes to the lowest point of its circle, having turned the instrument half round its axis, to bring the telescope into the position *mn*; if the cross hairs cover the same star supposed at *b*, the elevation of the axis *hfo* is exactly right; but if it be necessary to move the telescope into the position *uv*, in order to point to this star at *c*, the arch *mu*, which measures the angle *mfu*, or *bfc*, will be known; and then the axis *hfo* must be depressed half the quantity of this given angle if the star passed below *b*, or must be raised so much higher if above it; and then the trial must be repeated till the true elevation of the axis be obtained. By making the like observations upon the same star on each side the pole, in the six-o'clock-hour-circle, the error of the axis, toward the east or west may also be found and corrected, till the cross hairs follow the star quite round the pole: for supposing *aopbc* to be an arch of the meridian (or in the second practice of the six-o'clock-hour-circle), make the angle *afp* equal to half the angle *afc*, and the line *fp* will point to the pole; and the angle *ofp*, which is the error of the axis, will be equal to half the angle *bfc* or *mfu*, found by the observation; because the difference of the two angles *afb*, *afc*, is double the difference of their halves *afo* and *afp*. Unless the star be very near the pole, allowance must be made by refractions.

VI. Transit and Equal Altitude Instruments.

500 1. *The Transit Instrument* is used for observing objects as they pass over the meridian. It consists of a telescope fixed at right angles to an horizontal axis; which axis must be supported that what is called the line of collimation, or line of sight of the telescope, may move in the plane of the meridian. This instrument was first made by the celebrated Mr Romeur in the year 1689, and has since received great improvements. It is made of various sizes, and of large dimensions in our great observatories; but the following is one of a size sufficiently large and accurate for all the useful purposes.

The axis AB (fig. 220.), to which the middle of the telescope is fixed, is about $2\frac{1}{2}$ feet long, tapering gradually towards its ends, which terminate in cylinders well turned and smoothed. The telescope CD which is about four feet long and $1\frac{1}{4}$ inch diameter, is connected with the axis by means of a strong cube or die G, and in which the two cones MQ, forming the axis are fixed. This cube or stock G serves as the principal part of the whole machine. It not only keeps together the two cones, but holds the two sockets KH, of 15 inches length, for the two telescopic tubes. Each of these sockets has a square base, and is fixed to the cube by four screws. These sockets are cut down in the sides about eight inches, to admit more easily the tube of the telescope; but when the tube is inserted, it is kept in firm by screwing up the tightening screws at the end of the sockets at K and H. These two sockets are very useful in keeping the telescope in its greatest possible degree of steadiness. They also afford a better opportunity of balancing the telescope and rectifying its vertical thread, than by any other means.

In order to direct the telescope to the given height that a star would be observed at, there is fixed a semicircle AN on one of the supporters, of about $8\frac{1}{2}$ inches diameter, and divided into degrees. The index is fixed on the axis, at the end of which is a vernier, which subdivides the degrees into 12 parts or five minutes. This index is moveable on the axis, and may be closely applied to the divisions by means of a tightening screw.

Two upright posts of wood or stone YY, firmly fixed at a proper distance, are to sustain the supporters of this instrument. These supporters are two thick brass plates RR, having well smoothed angular notches in their upper ends, to receive the cylindrical arms of the axis. Each of these notched plates is contrived to be moveable by a screw which slides them upon the surfaces of two other plates immoveably fixed upon the two upright pillars; one plate moving in an horizontal, and the other in a vertical, direction; or, which is more simple, these two modes are sometimes applied only on one side, as at V and P, the horizontal motion by the screw P, and the vertical by the screw V. These two motions serve to adjust the telescope to the planes of the horizon and meridian: to the plane of the horizon by the spirit-level EF, hung by DC on the axis MQ, in a parallel direction; and to the plane of the meridian in the following manner:

Observe by the clock when a circumpolar star seen through this instrument transits both above and below the pole; and if the times of describing the eastern and western parts of its circuit are equal, the telescope is then in the plane of the meridian: otherwise the screw P must be gently turned that it may move the telescope

ſcope ſo much that the time of the ſtar's revolution be biſected by both the upper and lower tranſits, taking care at the ſame time that the axis remains perfectly horizontal. When the teleſcope is thus adjuſted, a mark muſt be ſet at a conſiderable diſtance (the greater the better) in the horizontal direction of the interſection of the croſs wires, and in a place where it can be illuminated in the night-time by a lanthorn hanging near it; which mark being on a fixed object, will ſerve at all times afterwards to examine the poſition of the teleſcope by, the axis of the inſtrument being firſt adjuſted by means of the level.

501 *To adjuſt the Clock by the Sun's Tranſit over the Meridian.* Note the times by the clock when the preceding and following edges of the ſun's limb touch the croſs-wires. The difference between the middle time and 12 hours, ſhows how much the mean, or time by the clock, is faſter or ſlower than the apparent, or ſolar time, for that day; to which the equation of time being applied, will ſhow the time of mean noon for that day, by which the clock may be adjuſted.

502 2. *The Equal Altitude Inſtrument* is an inſtrument that is uſed to obſerve a celeſtial object when it has the ſame altitude on both the eaſt and weſt ſides of the meridian, or in the morning and afternoon. It principally conſiſts of a teleſcope about 30 inches long fixed to a ſextantal or ſemicircular divided arch; the centre of which is fixed to a long vertical axis; but the particulars of the inſtrument the reader will ſee explained in OPTICS, Part III.

503 3. *Compound Tranſit Inſtrument.* Some inſtruments have been contrived to anſwer both kinds of obſervations, viz. either a tranſit or equal altitudes. Fig. 222 repreſents ſuch an inſtrument, made firſt of all for Mr Le Monnier the French aſtronomer, by the late Mr Siſſon, under the direction of Mr Opaham, mounted and fixed up ready for obſervation.

AB is a teleſcope, which may be 3, 4, 5, or 6 feet long, whoſe cylindrical tube fits exactly into another hollow cylinder *a b*, perpendicular to the axis: theſe ſeveral pieces are of the beſt hammered plate braſs. The cylindrical extremity of this axis NN are of ſolid bell-metal, and wrought exquiſitely true, and exactly of the ſame ſize in a lathe; and it is on the perfection to which the cylinders or trunnions are turned that the juſtneſs of the inſtrument depends. In the common focus of the object-glaſs and eye-glaſs is placed a reticle (fig. 223.) conſiſting of three horizontal and parallel fine-ſtretched ſilver wires, fixed by pins or ſcrews to a braſs circle, the middle one paſſing through its centre, with a fourth vertical wire likewiſe paſſing through the centre, exactly perpendicular to the former three.

The horizontal axis MN (fig. 222.) is placed on a ſtrong braſs frame, into the middle of which a ſteel cylinder GH is fixed perpendicularly, being turned truly round, and terminating in a conical point at its lower extremity; where it is let into a ſmall hole drilled in the middle of the dove-tail ſlider; which ſlider is ſupported by a hollow cube fixed to the ſupporting piece IK, conſiſting of two ſtrong plates of braſs, joined together at right angles, to which are fixed two iron cramps LL, by which it is faſtened to the ſtone-wall of a ſouth window.

The upper part G of the ſteel ſpindle is embraced by a collar *d e f*, being in contact with the blunt extremity of three ſcrews, whoſe particular uſe will be explained by and by. O is another cylindrical collar cloſely embracing the ſteel ſpindle at about a third part of its length from the top; by the means of a ſmall ſcrew it may be looſened or pinched cloſe as occaſion requires. From the bottom of this collar proceeds an arm or lever acted upon by the two ſcrews *g h*, whereby the whole inſtrument, excepting the ſupporting piece, may be moved laterally, ſo that the teleſcope may be made to point at a diſtant mark fixed in the vertical of the meridian. *i k* is a graduated ſemicircle of thin braſs ſcrewed to the teleſcope, whereby it may be elevated ſo as to point to a known celeſtial object in the day-time. *l m* is a ſpirit-level parallel to the axis of rotation on the teleſcope, on which two trunnions hang by two hooks at M and N. Along the upper ſide of the glaſs tube of the level ſlides a pointer to be ſet to the end of the air-bubble; and when the poſition of the axis of rotation is ſo adjuſted by the ſcrews that the air-bubble keeps to the pointer for a whole revolution of the inſtrument, the ſpindle GH is certainly perpendicular to the horizon, and then the line of collimation of the teleſcope deſcribes a circle of equal altitude in the heavens. When the level is ſuſpended on the axis, raiſe or depreſs the tube of the level by twiſting the neb of the ſcrew *n* till you bring either end of the air-bubble to reſt at any point towards the middle of the tube, to which ſlide the index; then lift off the level, and, turning the ends of it contrary ways, hang it again on the trunnions; and if the air-bubble reſts exactly again the index as before, the axis of rotation is truly horizontal: If not, depreſs that end of the axis which lies on the ſame ſide of the pointer as the bubble does, by turning the neb of the ſcrew at N, till the bubble returns about halfway towards the pointer; then having moved the pointer to the place where it now reſts, invert the ends of the level again, and repeat the ſame practice till the bubble reſts exactly at the pointer in both poſitions of the level. If, after the teleſcope is turned upſide down, that is, after the trunnions are inverted end for end, you perceive that the ſame point of a remote fixed object is covered by the vertical wire in the focus of the teleſcope that was covered by it before the inverſion, it is certain that the line of ſight or collimation is perpendicular to the tranſverſe axis; but if the ſaid vertical wire covers any other point, the braſs circle that carries the hairs muſt be moved by a ſcrew-key introduced through the perforation in the ſide of the tube at X, till it appears to biſect the line joining theſe two points, as near as you can judge; then, by reverting the axis to its former poſition, you will find whether the wires be exactly adjuſted. *N. B.* The ball *o* is a counterpoiſe to the centre of gravity of the ſemicircle *i k*, without which the teleſcope would not reſt in an oblique elevation without being fixed by a ſcrew or ſome other contrivance.

The ſeveral beforementioned verifications being accompliſhed, if the teleſcope be elevated to any angle with the horizon and there ſtopped, all fixed ſtars which paſs over the three horizontal wires of the reticle on the eaſtern ſide of the meridian in aſcending, will have preciſely the ſame altitudes when in deſcending they again croſs the ſame reſpective wires on the weſt

west side, and the middle between the times of each respective equal altitude will be the exact moment of the star's culminating or passing the meridian. By the help of a good pendulum-clock, the hour of their true meridional transits will be known, and consequently the difference of right ascension of different stars. Now, since it will be sufficient to observe a star which has north declination two or three hours before and after its passing the meridian, in order to deduce the time of its arrival at that circle; it follows, that having once found the difference of right ascension of two stars about 60 degrees asunder, and you again observe the first of these stand at the same altitude both in the east and west side, you infer with certainty the moment by the clock at which the second star will be on the meridian that same night, and by this means the transit-instrument may be fixed in the true plane of the meridian till the next day; when, by depressing it to some distant land objects, a mark may be discovered whereby it may ever after be rectified very readily, so as to take the transits of any of the heavenly bodies to great exactness, whether by night or day.

When such a mark is thus found, the telescope being directed carefully to it, must be fixed in that position by pinching fast the end of the arm or lever between the two opposite screws *g h*; and if at any future time, whether from the effect of heat or cold on the wall to which the instrument is fixed, or by any settling of the wall itself, the mark appears no longer well bisected by the vertical wire, the telescope may easily be made to bisect it again, by giving a small motion to the pinching screws.

The transit-instrument is now considered as one of the most essential particulars of the apparatus of an astronomical observatory.

Besides the above may be mentioned,

The EQUATORIAL *or* PORTABLE OBSERVATORY; 504
an instrument designed to answer a number of useful purposes in practical astronomy, independent of any particular observatory. It may be made use of in any steady room or place, and performs most of the useful problems in the science. The following is a description of one lately invented by Mr Ramsden, from whom it has received the name of the *Universal Equatorial*.

The principal parts of this instrument (fig. 221.) are, 1. The azimuth or horizontal circle A, which represents the horizon of the place, and moves on a long axis B, called the *vertical axis*. 2. The equatorial or hour-circle C, representing the equator, placed at right angles to the polar axis D, or the axis of the earth, upon which it moves. 3. The semicircle of declination E, on which the telescope is placed, and moving on the axis of declination, or the axis of motion of the line of collimation F. These circles are measured and divided as in the following table:

Measures of the several circles and divisions on them.	Radius In. dec.	Limb divided to	Nonius of 30 gives seconds	Divided on limb into parts of inc.	Divided by Nonius into parts of inch.
Azimuth or horizontal circle	5 1	15′	30″	45th	1350th
Equatorial or hour circle	5 1	15′ 1′ in time	30″ 2″	45th	1350th
Vertical semicircle for declination or latitude	5 5	15′	30″	42d	1260th

4. The telescope, which is an achromatic refractor with a triple object-glass, whose focal distance is 17 inches, and aperture 2.45 inches, and furnished with six different eye-tubes; so that its magnifying powers extend from 44 to 168. The telescope in this equatorial may be brought parallel to the polar axis, as in the figure, so as to point to the pole-star in any part of its diurnal revolution; and thus it has been observed near noon, when the sun has shone very bright. 5. The apparatus for correcting the error in altitude occasioned by refraction, which is applied to the eye-end of the telescope, and consists of a slide G moving in a groove or dove-tail, and carrying the several eye-tubes of the telescope, on which slide there is an index corresponding to five small divisions engraved on the dove-tail; a very small circle, called the refraction circle H, moveable by a finger-screw at the extremity of the eye-end of the telescope; which circle is divided into half-minutes, one entire revolution of it being equal to 3′ 18″, and by its motion raises the centre of the cross-hairs on a circle of altitude; and likewise a quadrant I of 1¼ inch radius, with divisions on each side, one expressing the degree of altitude of the object viewed, and the other expressing the minutes and seconds of error occasioned by refraction, corresponding to that degree of altitude: to this quadrant is joined a small round level K, which is adjusted partly by the pinion that turns the whole of this apparatus, and partly by the index of the quadrant: for which purpose the refraction circle is set to the same minute, &c. which the index points to on the limb of the quadrant; and if the minute, &c. given by the quadrant exceed the 3′ 18″ contained in one entire revolution of the refraction circle, this must be set to the excess above one or more of its entire revolutions; then the centre of the cross-hairs will apppear to be raised on a circle of altitude to the additional height which the error of refraction will occasion at that altitude.

This instrument stands on three feet L distant from each other 14,4 inches; and when all the parts are horizontal is about 29 inches high: the weight of the equatorial and apparatus is only 59 lb. avoirdupoise, which are contained in a mahogany case weighing 58 lb.

The principal adjustment in this instrument is that of making the line of collimation to describe a portion of an hour-circle in the heavens; in order to which, the azimuth circle must be truly level, the line of collimation

limation or some corresponding line represented by the small brass rod M parallel to it, must be perpendicular to the axis of its own proper motion; and this last axis must be perpendicular to the polar axis: on the brass rod M there is occasionally placed a hanging level N, the use of which will appear in the following adjustments:

The azimuth circle may be made level by turning the instrument till one of the levels is parallel to an imaginary line joining two of the feet screws; then adjust that level with these two feet screws; turn the circle half round, *i. e.* 180°; and if the bubble be not then right, correct half the error by the screw belonging to the level, and the other half error by the two foot screws; repeat this till the bubble comes right; then turn the circle 90° from the two former positions, and set the bubble right, if it be wrong, by the foot screw at the end of the level; when this is done, adjust the other level by its own screw, and the azimuth circle will be truly level. The hanging level must then be fixed to the brass rod by two hooks of equal length, and made truly parallel to it: for this purpose make the polar axis perpendicular or nearly perpendicular to the horizon; then adjust the level by the pinion of the declination-semicircle; reverse the level, and if it be wrong, correct half the error by a small steel screw that lies under one end of the level, and the other half error by the pinion of the declination-semicircle; repeat this till the bubble be right in both positions. In order to make the brass rod on which the level is suspended at right angles to the axis of motion of the telescope or line of collimation, make the polar axis horizontal, or nearly so: set the declination-semicircle to 0°, turn the hour-circle till the bubble comes right; then turn the declination-circle to 90°; adjust the bubble by raising or depressing the polar axis (first by hand till it be nearly right, afterwards tighten with an ivory key the socket which runs on the arch with the polar axis, and then apply the same ivory key to the adjusting screw at the end of the said arch till the bubble comes quite right); then turn the declination-circle to the opposite 90; if the level be not then right, correct half the error by the aforesaid adjusting screw at the end of the arch, and the other half error by the two screws which raise or depress the end of the brass rod. The polar axis remaining nearly horizontal as before, and the declination-semicircle at 0°, adjust the bubble by the hour-circle; then turn the declination-semicircle to 90°, and adjust the bubble by raising or depressing the polar axis; then turn the hour-circle 12 hours; and if the bubble be wrong, correct half the error by the polar axis, and the other half error by the two pair of capstan screws at the feet of the two supports on one side of the axis of motion of the telescope; and thus this axis will be at right angles to the polar axis. The next adjustment is to make the centre of cross-hairs remain on the same object, while you turn the eye-tube quite round by the pinion of the refraction apparatus: for this adjustment, set the index on the slide to the first division on the dove-tail; and set the division marked 18″ on the refraction-circle to its index; then look through the telescope, and with the pinion turn the eye-tube quite round; and if the centre of the hairs does not remain on the same spot during that revolution, it must be corrected by the four small screws, two and two at a time (which you will find upon unscrewing the nearest end of the eye-tube that contains the first eye-glass); repeat this correction till the centre of the hairs remains on the spot you are looking at during an entire revolution. In order to make the line of collimation parallel to the brass rod on which the level hangs, set the polar axis horizontal, and the declination-circle to 90°, adjust the level by the polar axis; look through the telescope on some distant horizontal object, covered by the centre of the cross hairs; then invert the telescope, which is done by turning the hour-circle half round; and if the centre of the cross hairs does not cover the same object as before, correct half the error by the uppermost and lowermost of the four small screws at the eye-end of the large tube of the telescope; this correction will give a second object now covered by the centre of the hairs, which must be adopted instead of the first object: then invert the telescope as before; and if the second object be not covered by the centre of the hairs, correct half the error by the same two screws which were used before: this correction will give a third object, now covered by the centre of the hairs, which must be adopted instead of the second object; repeat this operation till no error remains; then set the hour-circle exactly to 12 hours (the declination-circle remaining at 90° as before); and if the centre of the cross hairs does not cover the last object fixed on, set it to that object by the two remaining small screws at the eye-end of the large tube, and then the line of collimation will be parallel to the brass rod. For rectifying the nonius of the declination and equatorial circles, lower the telescope as many degrees, minutes, and seconds, below 0° or Æ on the declination-semicircle as are equal to the complement of the latitude; then elevate the polar axis till the bubble be horizontal, and thus the equatorial circle will be elevated to the co-latitude of the place; set this circle to 6 hours; adjust the level by the pinion of the declination-circle; then turn the equatorial circle exactly 12 hours from the last position; and if the level be not right, correct one half of the error by the equatorial circle, and the other half by the declination-circle; then turn the equatorial circle back again exactly 12 hours from the last position; and if the level be still wrong, repeat the correction as before till it be right, when turned to either position; that being done, set the nonius of the equatorial circle exactly to 6 hours, and the nonius of the declination-circle exactly to 0°.

The principal uses of this equatorial are,

1. To find your meridian by one observation only: for this purpose, elevate the equatorial circle to the co-latitude of the place, and set the declination-semicircle to the sun's declination for the day and hour of the day required; then move the azimuth and hour-circles both at the same time, either in the same or contrary direction, till you bring the centre of the cross hairs in the telescope exactly to cover the centre of the sun; when that is done, the index of the hour-circle will give the apparent or solar time at the instant of observation; and thus the time is gained, though the sun be at a distance from the meridian; then turn the hour-circle till the index points precisely at 12 o'clock, and lower the telescope to the horizon, in order to observe some point there-

Fig. 219.

Portable ASTRONOMICAL Quadrant.

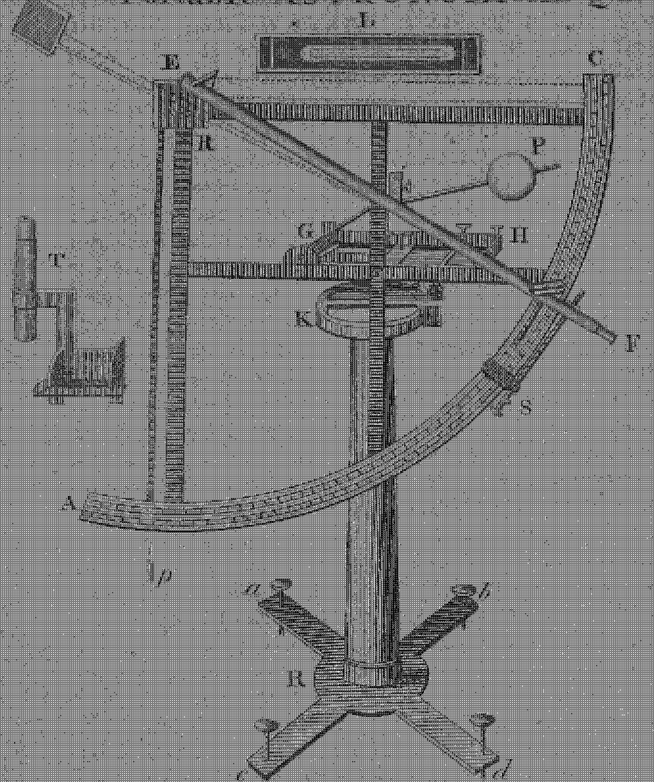


Fig. 220.

Transit Instrument

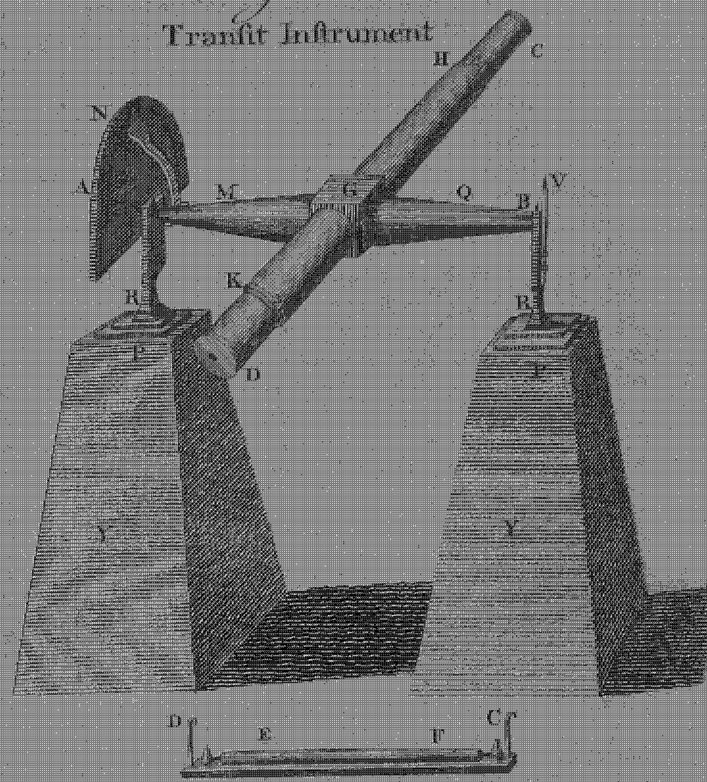


Fig. 221.

Universal Equatorial.

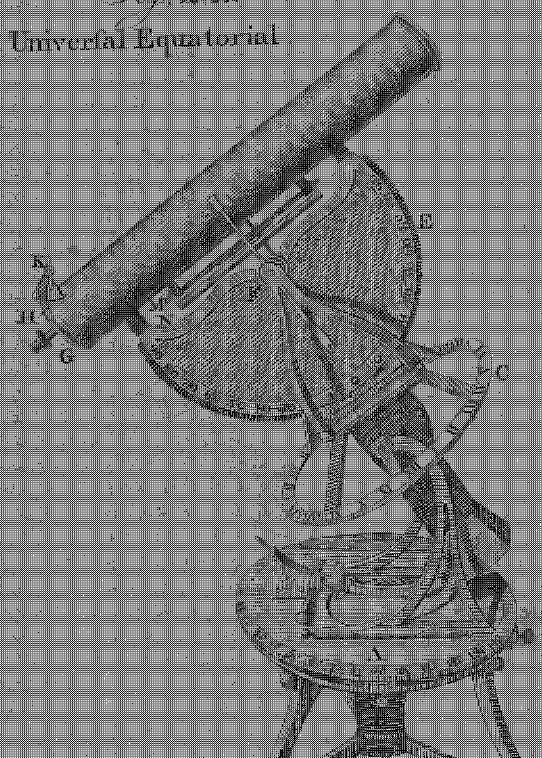


Fig. 223.

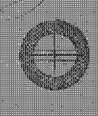
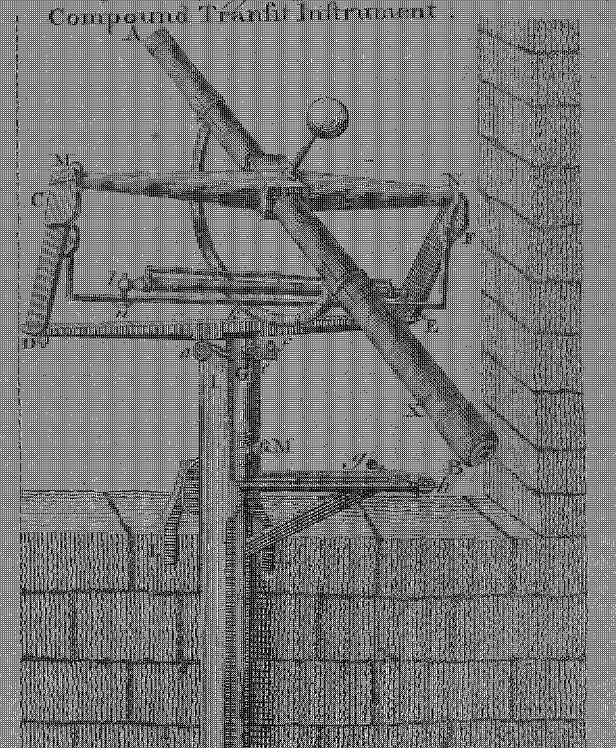


Fig. 222.

Compound Transit Instrument.



Thackara & Vallance sculp.

in the centre of your glass, and that point is your meridian mark found by one observation only; the best time for this operation is three hours before or three hours after 12 at noon.

2. To point the telescope on a star, though not on the meridian, in full day-light. Having elevated the equatorial circle to the co-latitude of the place, and set the declination-semicircle to the star's declination, move the index of the hour-circle till it shall point to the precise time at which the star is then distant from the meridian, found in tables of the right ascension of the stars, and the star will then appear in the glass. Besides these uses peculiar to this instrument, it is also applicable to all the purposes to which the principal astronomical instruments, viz. a transit, a quadrant, and an equal-altitude instrument, are applied.

INDEX.

A.

B.

Aſtrope-Wells ‖ Aſtruc.

ASTROPE-WELLS, near Banbury in Oxfordſhire, are recommended as excellent in female obſtructions, the gravel, hypochondriac, and ſimilar diſorders. The water is a briſk, ſpirituous, pleaſant-taſted chalybeate, and is alſo gently purgative. It ſhould be drank from three to five quarts in the forenoon.

ASTROSCOPE, a kind of aſtronomical inſtrument, compoſed of two cones, on whoſe ſurface the conſtellations, with their ſtars, are delineated, by means whereof the ſtars may eaſily be known. The aſtroſcope is the invention of William Schukhard, formerly profeſſor of mathematics at Tubingen, who publiſhed a treatiſe expreſsly on it in 1698.

ASTRUC (John), a celebrated phyſician, was born in the year 1684, at the little town of Savoy, in the province of Languedoc. His father, who was a proteſtant clergyman, beſtowed particular pains upon the earlieſt part of his education. After which he went to the univerſity of Montpelier, where he was created maſter of arts in the year 1700. He then began the ſtudy of medicine; and, in two years, obtained the degree of bachelor, having, upon that occaſion, written a diſſertation on the cauſe of fermentation, which he defended in a very ſpirited manner. On the 25th of January 1703 he was created doctor of phyſic; after which, before arriving at extenſive practice, he applied to the ſtudy of medical authors, both ancient and modern, with uncommon aſſiduity. The good effects of his ſtudy ſoon appeared; for, in the year 1710, he publiſhed a treatiſe concerning muſcular motion, from which he acquired very high reputation. In the year 1717, he was appointed to teach medicine at Montpelier; which he did with ſuch perſpicuity and eloquence, that it was univerſally ſaid he had been born to be a profeſſor. His fame ſoon roſe to ſuch a height, that the king aſſigned him an annual ſalary; and he was, at the ſame time, appointed to ſuperintend the mineral waters in the province of Languedoc. But as Montpelier did not afford ſufficient ſcope for his aſpiring genius, he went to Paris with a great ſtock of manuſcripts, which he intended to publiſh, after ſubjecting them to the examination of the learned. Soon after, however, he left it, having in the year 1729 accepted the office of firſt phyſician to the king of Poland, which was then offered to him. His ſtay in Poland, however, was but of ſhort duration, and he again returned to Paris. Upon the death of the celebrated Geoffroy, in the year 1731, he was appointed Regius Profeſſor of medicine at Paris. The duties of this office he diſcharged in ſuch a manner as to anſwer even the moſt ſanguine expectations. He taught the practice of phyſic with ſo great applauſe, as to draw from other univerſities to that of Paris a great concourſe of medical ſtudents, foreigners as well as natives of France. At the ſame time he was not more celebrated as a profeſſor than a practitioner. And, even at an advanced age, he perſiſted with unwearied aſſiduity in that intenſe ſtudy which firſt raiſed his reputation. Hence it is, that he has been enabled to tranſmit to poſterity ſo many valuable monuments of his medical erudition. He died, univerſally regretted, on the 15th of May 1766, in the 82d year of his age.

Aſturia.

ASTURIA, an ancient kingdom of Spain, ſubdued by Auguſtus emperor of Rome.—The inhabitants of this country, along with thoſe of Cantabria, aſſerted their liberty long after the reſt of Spain had received the Roman yoke. So great was their deſire of liberty, that, after being cloſely ſhut up by the Roman army, they endured the moſt terrible calamities of famine, even to the devouring of one another, rather than ſubmit to the enemy. At length, however, the Aſturians were for ſurrendering: but the Cantabrians oppoſed this meaſure, maintaining that they ought all to die ſword in hand like brave men. Upon this the two nations quarrelled, notwithſtanding their deſperate ſituation; and a battle enſuing, 10,000 of the Aſturians were driven to the intrenchments of the Romans, whom

whom they begged in the most moving manner to receive them on any terms they pleased. But Tiberius the emperor's son-in-law refusing to admit them into the camp, some of these unhappy people put an end to their lives by falling upon their own swords; others lighting great fires threw themselves into them, while some poisoned themselves by drinking the juice of a venomous herb.

The campaign being put an end to by winter, the next year the Asturians summoned all their strength and resolution against the Romans; but notwithstanding their utmost efforts of valour and despair, they were entirely defeated in a most bloody battle which lasted two days, and for that time entirely subdued. A few years afterwards they rebelled, in conjunction with the Cantabrians; but were soon reduced by the Romans, who massacred most of the young men that were capable of bearing arms. This did not prevent them from revolting anew in a short time afterwards; but without success, being obliged to submit to the Roman power, till the subversion of that empire by the Goths.

Asturias, anciently the kingdom of Asturia, is now a principality of modern Spain, bounded by Biscay on the east, Galicia on the west, Castile and Old Leon on the south, and the sea on the north. Its greatest length is about 110 miles, and its breadth 54. On the south it is separated from Castile and Old Leon by high mountains covered with woods. The province is tolerably fertile, but thinly inhabited. The inhabitants value themselves much on being descended from the ancient Goths. Even the poor peasants, who are fain to go to seek work in other provinces, call themselves *illustrious Goths* and *Mountaineers*, thinking it ignominious to marry even with great and rich families of another race. This pride is flattered by the respect paid them by the rest of the nation, and the privileges bestowed upon them by the government. The hereditary prince of Spain is styled *prince of the Asturias*. The most remarkable places in this principality are Oviedo, Gyon, Santillana, and St Andero.

ASTYAGES, son of Cyaxares, the last king of the Medes. He dreamed that from the womb of his daughter Mandane, married to Cambyses king of Persia, there sprung a vine that spread itself over all Asia. She being with child, he resolved to kill the infant as soon as born. Its name was Cyrus; and Harpagus, being sent to destroy it, preserved it: which Astyages after a long time hearing of, he caused Harpagus to eat his own son. Harpagus called in Cyrus, who dethroned his grandfather, and thereby ended the monarchy of the Medes. See Media and Persia.

ASTYANAX, the only son of Hector and Andromache. After the taking of Troy, he was thrown from the top of a tower by Ulysses's orders.

ASTYNOMI, in Grecian antiquity, magistrates in Athens, corresponding to the ædiles of the Romans; they were ten in number. See Ædile.

ASYLUM, a sanctuary, or place of refuge, where criminals shelter themselves from the hands of justice. The word is compounded of the primitive particle α, and συλαω, *I hurt*; because no person could be taken out of an asylum without sacrilege.

The asyla of altars and temples were very ancient; and likewise those of tombs, statues, and other monuments of considerable personages. Thus, the temple of Diana at Ephesus was a refuge for debtors, the tomb of Theseus for slaves. Among the Romans, a celebrated asylum was opened by Romulus between the mounts Palatine and Capitoline, in order to people Rome, for all sorts of persons indiscriminately, fugitive slaves, debtors, and criminals of every kind. The Jews had their asyla; the most remarkable of which were, the six cities of refuge, the temple, and the altar of burnt-offerings.

It was customary among the Heathens to allow refuge and impunity even to the vilest and most flagrant offenders: some out of superstition, and others for the sake of peopling their cities: and it was by this means, and with such inhabitants, that Thebes, Athens, and Rome, were first stocked. We even read of asylums at Lyons and Vienne among the ancient Gauls; and there are some cities in Germany which still preserve the ancient right of asylum. Hence on the medals of several ancient cities, particularly in Syria, we meet with the inscription ΑΣΥΛΟΙ, to which is added ΙΕΡΑΙ. This quality of asylum was given them, according to M. Spanheim, in regard to their temples, and to the gods revered by them.

The emperors Honorius and Theodosius granting the like immunities to churches, the bishops and monks laid hold of a certain tract or territory, without which they fixed the bounds of the secular jurisdiction: and so well did they manage their privileges, that convents in a little time became next akin to fortresses; where the most notorious villians were in safety, and braved the power of the magistrate.

These privileges at length were extended not only to the churches and church-yards, but also to the bishops houses; whence the criminal could not be removed without a legal assurance of life, and an entire remission of the crime. The reason of the extension was, that they might not be obliged to live altogether in the churches, &c. where several of the occasions of life could not be decently performed.

But at length these asyla or sanctuaries were also stripped of most of their immunities, because they served to make guilt and libertinage more bold and daring. In England, particularly, they were entirely abolished. See Sanctuary.

ASYMMETRY, the want of proportion between the parts of any thing; being the contrary of *symmetry*.

ASYMPTOTE, in geometry, a line which continually approaches nearer to another; but, though continued infinitely, will never meet with it: Of these are many kinds. In strictness, however, the term *asymptotes* is appropriated to right lines, which approach nearer and nearer to some curves of which they are said to be *asymptotes*; but if they and their curves are indefinitely continued, they will never meet. See Conic *Sections*.

ASYNDETON, in grammar, a figure which omits the conjunctions in a sentence. As in *veni, vidi, vici*, where et is left out: or in that of Cicero concerning Catiline, *abiit, excessit, evasit, erupit:* or in that verse of Virgil,

Ferte citi flammas, date vela, impellite remos.

Asyndeton stands opposed to polysyndeton, where the copulatives are multiplied.

ATABULUS, in physiology, a provincial wind in Apulia, of a dry pinching quality, and very noxious in its effects. The ancient naturalists speak of the Atabulus in terms of horror, on account of the ravage it made among the fruits of the earth, which it scorched or withered up.

ATABYRIS, a very high mountain in the island of Rhodes, on which, according to Strabo and Diodorus Siculus, there stood a temple of Jupiter Atabyrius, whose worship a colony of Rhodians carried into Sicily, where a temple was built to the same deity at Agrigentum.

ATALANTA, an island in the Euripus of Euboea, near the Locri Opuntii, said to have been originally a city of the Locri, but torn from the continent in the time of an earthquake, and during an irruption of mount Ætna. This happened in the fourth year of the 93d Olympiad, in the reign of Artaxerxes Mnemon (Pliny, Orosius).

ATALANTIS, ATLANTICA, or ATLANTIS. See ATLANTIS.

ATARAXY, a term used by the stoics and sceptics, to denote that calmness of mind which secures us from all emotions arising from vanity and self-conceit.

ATARGATIS FANUM, the temple of a goddess worshipped by the Syrians and Parthians, having the face of a woman and tail of a fish, and called *Derceto* by the Greeks. Her temple stood in the city Bambyce, called afterwards *Hierapolis*. It was extremely rich, insomuch that Crassus, in his march against the Parthians, spent several days in weighing the treasure. Vossius makes the name of this goddess Phoenician, from *Addir-dag*, "the great fish."

ATARNEA, an ancient town of Mysia, situated between Adramyttium and Pitane, remarkable for the marriage of Aristotle with the sister or concubine of the tyrant Hermias; also for the dottage of that philosopher.

ATAXY, in a general sense, the want of order: With physicians, it signifies irregularity of crises and paroxysms of fevers.

ATCHE, in commerce, a small silver coin used in Turkey, and worth only one-third of the English penny.

ATCHIEVEMENT, in heraldry, denotes the arms of a person or family, together with all the exterior ornaments of the shield; as helmet, mantle, crest, scrolls, and motto, together with such quarterings as may have been acquired by alliances, all marshalled in order.

ATCHIEVE. This term is derived from the French *achever*, i. e. to finish or make an end of; but signifies, in its ordinary acceptation, to perform great actions or exploits.

ATE, the goddess of mischief, in the Pagan theology. She was daughter of Jupiter, and cast down from heaven at the birth of Hercules. For Juno having deceived Jupiter, in causing Euristheus to be born before Hercules, Jupiter expressed his resentment on Ate, as the author of that mischief: and threw her headlong from heaven to earth, swearing she should never return thither again (*Homeri Il.* xix. 125.) The name of this goddess comes from *αταω*, *noceo*, to "hurt." Her being the daughter of Jupiter, means, according to mythologists, that no evil happens to us but by the permission of Providence; and her banishment to earth denotes the terrible effects of divine justice among men.

ATEGUA, or ATTEGUA, an ancient town of Spain, placed by some in the road from Antiquara, now Antequera, to Hispalis, or Seville; by others near Alcala Real; which last is the more probable situation, because the flumen salsum, now the Salado, was in its neighbourhood. Now *Tebala Vieja*, or *Teivela*.

ATELLA, an ancient town of Campania in Italy, between Capua and Neapolis. From this town the *Atellanæ fabulæ*, or *Atellani ludi*, took their name. These were also called *Osci*, from their inventor, in whose territory Atella lay. They were generally a species of farce, interlarded with much ribaldry and buffoonery; and sometimes were exordia or interludes presented between the acts of other plays. The actors in these farces were not reckoned among the common players, nor deemed infamous; but retained the rights of their tribe, and might be listed for soldiers, the privilege only of free men. The ruins of this town are still to be seen about 11 miles from the modern Aversa, which was built out of its materials.

ATEMPO GIUSTO, in music, signifies to sing or play in an equal, true, and just time.

ATERGATIS, in mythology, a goddess of the Syrians, supposed to be the mother of Semiramis. She was represented with the face and breasts of a woman, but the rest of her body resembled a fish. Vossius says the term signifies *without fish*, and conjectures that the votaries of this deity abstained from fish.

ATERNUM, a town of Lucania in Italy, now *Aterni*, (Cluverus): Also a town in the territory of the Piceni, now *Pescara*, a port-town of Naples, situated on the Adriatic, E. Long. 15. 25. N. Lat. 42. 30.

ATESTE, a town in the territory of Venice in Italy, now called *Este*. E. Long. 12. 6. N. Lat. 45. 25.

ATHAMADULET, the prime minister of the Persian empire, as the grand vizier is of the Turkish empire. He is great chancellor of the kingdom, president of the council, superintendant of the finances, and is charged with all foreign affairs.

ATHAMANTA, SPIGNEL: A genus of the dinynia order, belonging to the pentandria class of plants; and in the natural method ranking under the 45th order, *Umbellatæ*. The fruit is oblong and striated; and the petals are inflected and emarginated. Of this genus Linnæus enumerates nine species; but none of them merit particular notice, except the cretensis, otherwise called *daucus creticus*, which grows wild in the Levant and the warmer parts of Europe. The leaves are irregularly disposed, and formed like those of fennel. The flower-stalk rises about two feet high, sending out many branches, terminated at the top by compound umbels, composed of near 20 small ones. These have white flowers with five petals, which are succeeded by oblong, hairy, channelled fruit, divided into two parts, containing one oblong hairy seed. The seeds have a warm biting taste, with an agreeable aromatic smell. They are kept in the shops as a medicine, are carminative, and said to be diuretic; but are little used in practice. The plant may be propagated

gated from seeds, which should be sown on an open bed of light dry ground; the following autumn the plants should be taken up, and planted at about a foot distance in a bed of light sandy earth, where the roots will continue several years.

ATHANASIA, GOLDILOCKS: A genus of the polygamia æqualis order, belonging to the syngenesia class of plants; and in the natural method ranking under the 49th order, *Compositæ discoides*. The receptacle is chaffy; the pappus is chaffy, and very short; and the calyx is imbricated. There are 20 species, all tender plants except one; and none of them possessed of beauty, or any remarkable property.

ATHANASIAN CREED; a formulary, or confession of faith, long supposed to have been drawn up by Athanasius bishop of Alexandria, in the fourth century, to justify himself against the calumnies of his Arian enemies. But it is now generally allowed among the learned not to have been his. Dr Waterland ascribes it to Hilary bishop of Arles, for the following among other reasons: 1. Because Honoratus of Marseilles, the writer of his life, tells us, that he composed an *Exposition of the Creed*: a properer title for the *Athanasian*, than that of *Creed* simply which it now bears. 2. Hilary was a great admirer and follower of St Austin; and the whole composition of this creed is in a manner upon St Austin's plan, both with respect to the Trinity and incarnation. 3. It is agreeable to the style of Hilary, as far as we can judge from the little that is left of his works. Upon the whole, he concludes, that Hilary bishop of Arles, about the year 430, composed *The Exposition of Faith*, which now bears the name of the *Athanasian Creed*, for the use of the Gallican clergy, and particularly those of the diocese of Arles: That, about the year 570, it became famous enough to be commented upon; but that all this while, and for several years lower, it had not yet acquired the name of *Athanasian*, but was simply styled *The Catholic Faith*: That, before 670, Athanasius's admired name came in to recommend and adorn it, being in itself an excellent system of the Athanasian principles of the Trinity and incarcation, in opposition chiefly to the Arians, Macedonians, and Apollinarians. This is the hypothesis of the learned author of the *Critical History of the Athanasian Creed*.

As to the reception of this creed in the Christian churches, we find, that it obtained in France in the time of Hincmar, or about 850; that it was received in Spain about 100 years later than in France, and in Germany much about the same time. As to our own country, we have clear and positive proofs of this creed being sung alternately in our churches in the tenth century. It was in common use in some parts of Italy, particularly in the diocese of Verona, about the year 960, and was received at Rome about the year 1014. As to the Greek and oriental churches, it has been questioned whether any of them ever received this creed at all; though some very considerable writers are of a contrary persuasion. It appears then, that the reception of this creed has been both general and ancient; and may vie with any, in that respect, except the Nicene, or Constantinopolitan, the only general creed common to all the churches.

As to the matter of this creed, it is given as a summary of the true orthodox faith, and a condemnation of all heresies ancient and modern. Unhappily, however, it has proved a fruitful source of unprofitable controversy and unchristian animosity even down to the present time.

ATHANASIUS (St), bishop of Alexandria, and one of the greatest defenders of the faith against the Arians, was born in Egypt. He followed St Alexander to the council of Nice, in 325, where he disputed against Arius, and the following year was made bishop of Alexandria; but, in 335, was deposed by the council of Tyre: when, having recourse to the emperor Constantine, the Arian deputies accused him of having hindered the exportation of corn from Alexandria to Constantinople; on which the emperor, without suffering him to make his defence, banished him to Treves. The emperor, two years after, gave orders that he should be restored to his bishopric: but, on his return to Alexandria, his enemies brought fresh accusations against him, and chose Gregory of Cappadocia to his see; which obliged Athanasius to go to Rome to reclaim it of Pope Julius. He was there declared innocent, in a council held in 342, and in that of Sardica in 347, and two years after was restored to his see by order of the emperor Constans; but after the death of that prince, he was again banished by the emperor Constantius, which obliged him to retire into the deserts. The Arians then elected one George in his room; who being killed in a popular sedition under Julian in 360, St Athanasius returned to Alexandria, but was again banished under Julian, and restored to his see under Jovian. He addressed to that emperor a letter, in which he proposed that the Nicene creed should be the standard of the orthodox faith, and condemned those who denied the divinity of the Holy Ghost. He was also banished by Valens in 367, and afterwards recalled. St Athanasius died on the 2d of May 373.

His works principally contain a defence of the mystery of the Trinity, and of the incarnation and divinity of the Word and Holy Spirit. There are three editions of his works which are esteemed; that of Commelin, printed in 1600; that of Peter Nannius, in 1627; and that of father Montfaucon. As to the creed which bears his name, see the preceding article.

ATHANATI, in Persian antiquity, a body of cavalry, consisting of 10,000 men, always complete. They were called *athanati* (a word originally Greek, and signifying *immortal*), because, when one of them happened to die, another was immediately appointed to succeed him.

ATHANOR. Chemists have distinguished by this name a furnace so constructed that it can always maintain an equal heat, and which shall last a long time without addition of fresh fuel.

The body of the athanor has nothing in it particular, and is constructed like ordinary furnaces. But at one of its sides, or its middle, there is an upright hollow tower, which communicates with the fire-place by one or more sloping openings. This tower ought to have a lid which exactly closes its upper opening.

When the athanor is to be used, as much lighted coal is put in the fire-place as is judged necessary, and the tower is filled to the top with unlighted fuel. The tower is then to be exactly closed with its lid. As fast as the coal in the fire-place is consumed, that in the tower falls down and supplies its place. As the coal contained in the tower has no free communication with the external air, it cannot burn till it falls into the fire-place.

The athanor being much celebrated and used by ancient chemists, it has been particularly described by many authors, and was formerly found in all laboratories. At present this furnace is much less employed, and is even neglected. The reason of this is, that all the ancient chemists were in search of the art of making gold; and being excited by this powerful desire, and confidence of success, they spared no trouble nor expence to accomplish this design. They undertook, without hesitation, operations which required great length of time and unremitted heat. Whereas now, these alluring hopes having vanished, the cultivators of chemistry have no other view than to extend and perfect the theory of this essential part of natural philosophy. This motive, although undoubtedly much nobler than the former, seems, however, to be less powerful over most men. For now, all long and laborious operations whence chemistry might receive great advantages, are neglected, as being tiresome and disgustful. There is, in fact, a considerable difference betwixt the hope of explaining a philosophical phenomenon, and that of obtaining an ingot of gold capable of producing many others. Hence the instruments employed in long operations, and particularly the athanor, are now much neglected; and also because the fuel in the tower is apt to stick there or fall down at once in too great quantity. The lamp-furnace, which is a true athanor, may be successfully employed in operations which do not require much heat.

ATHAROTH, or Atroth, (anc. geog.) the name of several towns. Two appear to have been in Samaria, in the tribe of Ephraim; the one four miles to the north of Sebaste, or the city of Samaria; the other in the confines of Benjamin and Ephraim, yet so as to be of the resort of Ephraim rather than of Benjamin (Joshua). This is the *Atroth-Addar* mentioned Joshua xvi. 5. from which to Upper Beth-horon extends the greatest breadth of the tribe of Ephraim.

ATHEISM, the disbelief of a Deity. See Atheist.

ATHEIST, a person who does not believe the existence of a Deity. Many people, both ancient and modern, have pretended to atheism, or have been reckoned atheists by the world; but it is justly questioned whether any man seriously adopted such a principle. These pretensions, therefore, must be founded on pride or affectation.

Atheism, as absurd and unreasonable as it is, has had its martyrs. Lucilio Vanini, an Italian, native of Naples, publicly taught atheism in France, about the beginning of the 16th century; and, being convicted of it at Tolouse, was condemned to death. Being pressed to make public acknowledgement of his crime, and to ask pardon of God, the king, and justice, he answered, he did not believe there was a God; that he never offended the king; and, as for justice, he wished it to the devil. He confessed that he was one of twelve, who parted in company from Naples to spread their doctrine in all parts of Europe. His tongue was first cut out, and then his body burnt, April 9. 1619.

Cicero represents it as a probable opinion, that they who apply themselves to the study of philosophy believe there are no gods. This must, doubtless, be meant of the academic philosophy, to which Cicero himself was attached, and which doubted of every thing. On the contrary, the Newtonian philosophers are continually recurring to a Deity, whom they always find at the end of their chain of natural causes. Some foreigners have even charged them with making too much use of the notion of a God in philosophy, contrary to the rule of Horace:

Nec Deus intersit, nisi dignus vindici nodus.

Among us, the philosophers have been the principal advocates for the existence of a Deity. Witness the writings of Sir Isaac Newton, Boyle, Ray, Cheyne, Nieuwentyt, &c. To which may be added many others, who, though of the clergy (as was also Ray), yet have distinguished themselves by their philosophical pieces in behalf of the existence of a God; *e. gr.* Derham, Bentley, Whiston, Samuel and John Clarke, Fenelon, &c. So true is that saying of Lord Bacon, that though a smattering of philosophy may lead a man into atheism, a deep draught will certainly bring him back again to the belief of a God and Providence.

ATHELING, Adeling, Edling, Ethling, or Etheling, among the Anglo-Saxons, was a title of honour, properly belonging to the heir-apparent, or presumptive, to the crown. This honourable appellation was first conferred by king Edward the Confessor on Edgar, to whom he was great uncle, when, being without any issue of his own, he intended to make him his heir.

ATHELSTAN, a Saxon king of England, natural son of Edward the elder, and grandson of the great Alfred. He succeeded to the crown in 925, and reigned 16 years. There was a remarkable law passed by this prince, which shows his just sentiments of the advantages of commerce, as well as the early attention to it in this country: it declared, that any merchant who made three voyages on his own account beyond the British channel or narrow seas, should be intitled to the privilege of a thane, or gentleman.

ATHENÆA, in antiquity, a feast celebrated by the ancient Greeks in honour of Minerva, who was called *Athene*.

ATHENÆUM, in antiquity, a public place wherein the professors of the liberal arts held their assemblies, the rhetoricians declaimed, and the poets rehearsed their performances. These places, of which there were a great number at Athens, were built in the manner of amphitheatres, encompassed with seats, called *cunei*. The three most celebrated Athenæa were those at Athens, at Rome, and at Lyons, the second of which was built by the emperor Adrian.

ATHENÆUS, a physician, born in Cilicia, cotemporary with Pliny, and founder of the pneumatic sect. He taught that the fire, air, water, and earth, are not the true elements, but that their qualities are, viz. heat, cold, moisture, and dryness; and to these he added a fifth element, which he called *spirit*, whence his sect had its name.

Athenæus, a Greek grammarian, born at Naucratis

cratis in Egypt in the 3d century, one of the most learned men of his time. Of all his works we have none extant but his Deipnosophis, *i. e.* the sophists at table; there is an infinity of facts and quotations in this work which render it very agreeable to admirers of antiquity.

There was also a mathematician of this name, who wrote a treatise on mechanics, which is inserted in the works of the ancient mathematicians, printed at Paris in 1693, in folio, in Greek and Latin.

ATHENAGORAS, an Athenian philosopher, flourished about the middle of the 2d century; and was remarkable for his zeal for Christianity, and his great learning, as appears from the apology which he addressed to the emperors Marcus Aurelius Antoninus and Lucius Commodus.

ATHENODORUS, a famous stoic philosopher, born at Tarsus, went to the court of Augustus, and was made by him tutor to Tiberius. Augustus had a great esteem for him, and found him by experience a man of virtue and probity. He used to speak very freely to the emperor. He, before he left the court to return home, warned the emperor not to give himself up to anger, but, whenever he should be in a passion, to rehearse the 24 letters of the alphabet before he resolved to say or do any thing. He did not live to see his bad success in the education of Tiberius.

ATHENOPOLIS, a town of the Massilienses, an ancient nation of Gaul. It is conjectured by Harduin to be the same with *Telo Martius*, now *Toulon*; by others to be the same with *Antipolis* or *Antibes*.

ATHENREE, a town of Ireland in the county of Galway, and province of Connaught. W. Long. 8.5. N. Lat. 53. 14. It is governed by a portrieve, and hath a barrack for three companies of foot. It hath been a place of considerable strength; but, like the numerous churches and castles which surround it, has felt the resistless force of time. Some of the walls and towers, however, are still remaining, as monuments of its former grandeur.

ATHENS, a celebrated city of Greece, and capital of the ancient kingdom of Attica, situated in E. Long. 53. N. Lat. 38.5. See ATTICA.

1 By whom founded.

In early times, that which was afterwards called the *citadel* was the whole city; and went under the name of *Cecropia*, from its founder Cecrops, whom the Athenians in after times affirmed to have been the first builder of cities, and called this therefore by way of eminence *Polis*, i. e. the city. In the reign of Erichthonius it lost the name of *Cecropia*, and acquired that of *Athens*, on what account is not certain; the most probable is, that it was so named in respect to the goddess Minerva, whom the Greeks call *Athene*, who was also esteemed its protectress. This old city was seated on the top of a rock in the midst of a large and pleasant plain, which, as the number of inhabitants increased, became full of buildings, which induced the distinction of Acro and Catapolis, *i. e.* of the upper and lower city. The extent of the citadel was 60 stadia; it was surrounded by olive trees, and fortified, as some say, with a strong palisade; in succeeding times it was encompassed with a strong wall, in which there were nine gates, one very large one, and the rest small. The inside of the citadel was adorned with innumerable edifices. The most remarkable of which were, 1. The magnificent temple of Minerva, styled *parthenion*, because that goddess was a virgin. The Persians destroyed it; but it was rebuilt with still greater splendor by the famous Pericles, all of the finest marble, with such skill and strength, that, in spite of the rage of time and barbarous nations, it remains perhaps the first antiquity in the world, and stands a witness to the truth of what ancient writers have recorded of the prodigious magnificence of Athens in her flourishing state. 2. The temple of Neptune and of Minerva; for it was divided into two parts: one sacred to the god, in which was the salt fountain said to have sprung upon the stroke of his trident; the other to the goddess protectress of Athens, wherein was the sacred olive which she produced, and her image which fell down from heaven in the reign of Erichthonius. At the back of Minerva's temple was the public treasury, which was burnt to the ground through the knavery of the treasurers, who, having misapplied the revenues of the state, took this short method of making up accounts.

2 Remarkable buildings,

The lower city comprehended all the buildings surrounding the citadel, the fort Munychia, and the havens Phalerum and Piræus, the latter of which was joined to the city by walls five miles in length; that on the north was built by Pericles, but that on the south by Themistocles; but by degrees the turrets which were at first erected on those walls were turned into dwelling-houses for the accommodation of the Athenians, whose large city was now become too small for them. The city, or rather the lower city, had 13 great gates, with the names of which it is not necessary to trouble the reader. Among the principal edifices which adorned it, we may reckon, 1. The temple of Theseus, erected by Conon, near its centre. Adjacent thereto, the young people performed their exercises. It was also a sanctuary for distressed persons, slaves or free. 2. The Olympian temple erected in honour of Jupiter, the honour of Athens, and of all Greece. The foundation of it was laid by Pisistratus: it was carried on but slowly in succeeding times, 700 years elapsing before it was finished, which happened under the reign of Adrian, who was particularly kind to Athens: this was the first building in which the Athenians beheld pillars. 3. The pantheon, dedicated to all the gods; a most noble structure, supported by 120 marble pillars, and having over its great gate two horses carved by Praxiteles: it is yet remaining, as we shall have occasion to show hereafter when we come to speak of the present state of this famous city. In several parts of it were *staoi* or porticos, wherein people walked in rainy weather, and from whence a sect of philosophers were denominated *stoics*, because their master Zeno taught in those porticos.

3 Ceramicus.

There were at Athens two places called *Ceramicus*, from Ceramus the son of Bacchus and Ariadne; one within the city, containing a multitude of buildings of all sorts; the other in the suburbs, in which was the academy and other edifices. The Gymnasia of Athens were many; but the most remarkable were the Lyceum, Academia, and Cynosarges. The Lyceum stood on the banks of Ilissus; some say it was built by Pisistratus, others by Pericles, others by Lycurgus. Here Aristotle taught philosophy, instructing such as came

Athens. to hear him as they walked, whence his disciples are generally thought to derive the name of *peripatetics*. The ceramicus without the city was the distance of six stadia from its walls. The academy made part thereof; as to the name of which there is some dispute. Some affirm that it was so called from Academus, an ancient hero, who, when Helen was stolen by Theseus, discovered the place where she lay hid to Castor and Pollux: for which reason the Lacedemonians, when they invaded Attica always spared this place. Dicæarchus writes, that Castor and Pollux had two Arcadians in their army, the one named *Echedemus*, the other *Marothus;* from the former of these he says this place took its name, and that the borough of Marathon was so called from the other. It was a marshy unwholesome place, till Cimon was at great pains to have it drained; and then it became extremely pleasant and delightful, being adorned with shady walks, where Plato read his lectures, and from thence his scholars were styled *academics*.

4 Cynosarges. The Cynosarges was a place in the suburbs not far from the Lyceum: it was famous on many accounts; but particularly for a noble gymnasium erected there, appointed for the special use of such as were Athenians only by one side. In after times Themistocles derived to himself ill-will, by carrying many of the nobility to exercise with him here, because, being but of the half blood, he could exercise no where else but in this gymnasium. Anthisthenes instituted a sect of philosophers, who from the name of this district, as many think, were styled *Cynics*.

5 Havens. The havens of Athens were three. First the Pyræus, which was distant about 35 or 40 stadia from the city, till joined thereto by the long walls beforementioned, after which it became the principal harbour of the city, It had three docks; Cantharos, Aphrodisium, and Zea: the first was so called from an ancient hero, the second from the goddess Venus who had there two temples, and the third from bread-corn. There were in this port five porticos, which joining together formed one great one called from thence *Macra Stoa*, or the grand portico. There were likewise two great markets or fora; one near the long portico, the other near the city. The second port was Munichia, a promontory not far distant from Pyræus; a place very strong by nature, and afterwards rendered far stronger by art. It was of this that Epimenides said, if the Athenians foresaw what mischief it would one day produce to them, they would eat it away with their teeth. The third was Phalerum, distant from the city, according to Thucydides 35 stadia, but according to Pausanias only 20. This was the most ancient harbour of Athens, as Pyræus was the most capacious.

6 Present state. Of this city, as it stands at present, we have the following account by Dr Chandler. "It is now called *Athini*; and is not inconsiderable, either in extent or the number of inhabitants. It enjoys a fine temperature, and serene sky. The air is clear and wholesome, though not so delicately soft as in Ionia. The town stands beneath the Archopolis or citadel; not encompassing the rock as formerly, but spreading into the plain, chiefly on the west and north-west. Corsairs infesting it, the avenues were secured, and in 1676 the gates were regularly shut after sunset. It is now open again; but several of the gateways remain, and a guard of Turks patrols at midnight. Some masses of brick work, standing separate, without the town, belonged perhaps to the ancient wall, of which other traces also appear. The houses are mostly mean and straggling; many with large areas or courts before them. In the lanes, the high walls on each side, which are commonly whitewashed, reflect strongly the heat of the sun. The streets are very irregular; and anciently were neither uniform nor handsome. They have water conveyed in channels from mount Hymettus, and in the bazar or market-place is a large fountain. The Turks have several mosques and public baths. The Greeks have convents for men and women; with many churches, in which service is regularly performed; and besides these, they have numerous oratories or chapels, some in ruins or consisting of bare walls, frequented only on the anniversaries of the saints to whom they are dedicated. A portrait of the owner on a board is placed in them on that occasion, and removed when the solemnity of the day is over.

7 Citadel, or city of Cecrops. "The city of Cecrops is now a fortress with a thick irregular wall, standing on the brink of precipices, and inclosing a large area about twice as long as broad. Some portions of the ancient wall may be discovered on the outside, particularly at the two extreme angles; and in many places it is patched with pieces of columns, and with marbles taken from the ruins. A considerable sum had been recently expended on the side next Hymettus, which was finished before we arrived. The scaffolding had been removed to the end toward Pentele; but money was wanting, and the workmen were withdrawn. The garrison consists of a few Turks, who reside there with their families, and are called by the Greeks *Castriani*, or the soldiers of the castle. The rock is lofty, abrupt, and inaccessible, except the front, which is towards the Piræus; and on that quarter is a mountainous ridge, within cannon-shot. It is destitute of water fit for drinking; and supplies are daily carried up in earthen jars, on horses and asses, from one of the conduits in the town.

"The acropolis furnished a very ample field to the ancient virtuosi. It was filled with monuments of Athenian glory, and exhibited an amazing display of beauty, of opulence, and of art; each contending as it were for the superiority. It appeared as one entire offering to the Deity, surpassing in excellence and astonishing in richness. Heliodorus, named Periegetes *the guide*, had employed on it 15 books. The curiosities of various kinds, with the pictures, statues, and pieces of sculpture, were so many and so remarkable, as to supply Polemo Periegetes with matter for four volumes; and Strabo affirms, that as many would be required in treating of other portions of Athens and of Attica. In particular, the number of statues was prodigious. Tiberius Nero, who was fond of images, plundered the acropolis as well as Delphi and Olympia; yet Athens, and each of these places, had not fewer than 3000 remaining in the time of Pliny. Even Pausanias seems here to be distressed by the multiplicity of his subject. But this banquet, as it were, of the senses has long been withdrawn; and is now become like the tale of a vision. The spectator views with concern the marble ruins intermixed with mean flat-roofed cottages, and extant amid rubbish; the sad memorials of a nobler people; which, however, as visible from the sea, should have introduced modern Athens

thens to more early notice. They who reported it was only a ſmall village, muſt, it has been ſurmiſed, have beheld the acropolis through the wrong end of their teleſcopes.

" The acropolis has now, as formerly, only one entrance, which fronts the Piræus. The aſcent is by traverſes and rude fortifications furniſhed with cannon, but without carriages, and neglected. By the ſecond gate is the ſtation of the guard, who ſits croſs-legged under cover, much at his eaſe, ſmoking his pipe, or drinking coffee, with his companions about him in like attitudes. Over this gate-way is an inſcription in large characters on a ſtone turned upſide down, and black from the fires made below. It records a preſent of a pair of gates.

8 Propyléa.

" Going farther up, you come to the ruins of the propyléa, an edifice which graced the entrance into the citadel. This was one of the ſtructures of Pericles, who began it when Euthymenes was archon, 435 years before Chriſt. It was completed in five years, at the expence of 2012 talents. It was of marble, of the Doric order, and had five doors to afford an eaſy paſſage to the mulitudes which reſorted on buſineſs or devotion to the acropolis.

" While this fabric was building, the architect Mneſicles, whoſe activity equalled his ſkill, was hurt by a fall, and the phyſicians deſpaired of his life; but Minerva, who was propitious to the undertaking, appeared, it was ſaid, to Pericles, and preſcribed a remedy, by which he was ſpeedily and eaſily cured. It was a plant or herb growing round about the acropolis, and called afterwards *parthenium*.

9 Temple of Victory.

" The right wing of the propyléa was a temple of Victory. They related that Ægeus had ſtood there, viewing the ſea, and anxious for the return of his ſon Theſeus, who was gone to Crete with the tributary children to be delivered to the Minotaur. The veſſel which carried them had black ſails ſuiting the occaſion of its voyage; and, it was agreed, that, if Theſeus overcame the enemy, their colour ſhould be changed to white. The neglect of this ſignal was fatal to Ægeus, who, on ſeeing the ſails unaltered, threw himſelf down headlong from the rock, and periſhed. The idol was named *Victory without wings;* it was ſaid, becauſe the news of the ſucceſs of Theſeus did not arrive but with the conqueror. It had a pomegranate in the right hand, and an helmet in the left. As the ſtatue was without pinions, it was hoped the goddeſs would remain forever on the ſpot.

" On the left wing of the propyléa, and fronting the temple of Victory, was a building decorated with paintings by Polygnotus, of which an account is given by Pauſanias. This edifice, as well as the temple, was of the Doric order, the columns fluted, and without baſes. Both contributed alike to the uniformity and grandeur of the deſign; and the whole fabric, when finiſhed, was deemed equally magnificent and ornamental. The interval between Pericles and Pauſanias conſiſts of ſeveral centuries. The propyléa remained entire in the time of this topographer; and, as will be ſhown, continued nearly ſo to a much later period. It had then a roof of white marble, which was unſurpaſſed either in the ſize of the ſtones or in the beauty of their arrangement; and before each wing was an equeſtrian ſtatue.

" The propyléa have ceaſed to be the entrance of the acropolis. The paſſage, which was between the columns in the centre, is walled up almoſt to their capitals, and above is a battery of cannon. The way now winds before the front of the ancient ſtructure; and turning to the left hand among rubbiſh and mean walls, you come to the back part, and to the five door-ways. The ſoil without is riſen higher than the top of the two ſmaller. There, under the vault and cannon, lies an heap of large ſtones, the ruin of the roof.

" The temple of Victory, ſtanding on an abrupt rock, has its back and one ſide encumbered with the modern ramparts. The columns in the front being walled up, you enter it by a breach in the ſide, within 10

Roof carried off by an exploſion.

the propyléa. It was uſed by the Turks as a magazine for powder, until about the year 1656, when a ſudden exploſion, occaſioned by lightning, carried away the roof, with a houſe erected on it, belonging to the officer who commanded in the acropolis, whoſe family, except a girl, periſhed. The women of the Aga continued to inhabit in this quarter, but it is now abandoned and in ruins.

" The cell of the temple of Victory, which is of white marble, very thick, and ſtrongly cemented, ſufficiently witneſſes the great violence it has undergone; the ſtones in many places being disjointed, as it were, and forced from their original poſition. Two of theſe making an acute angle, the exterior edges touching, without a crevice; and the light abroad being much ſtronger than in the room, which has a modern roof and is dark; the portion in contact becoming pellucid, had illumined the vacant ſpace with a dim colour reſembling that of amber. We were deſired to examine this extraordinary appearance, which the Greeks regarded as a ſtanding miracle, and which the Turks, who could not confute them, beheld with equal aſtoniſhment. We found in the gape ſome coals, which had been brought on a bit of earthen ware for the purpoſe of burning incenſe, as we ſuppoſed, and alſo a piece of wax-taper, which probably had been lighted in honour of the ſaint and author of the wonder; but our Swiſs unfortunately carrying his own candle too far in, the ſmoke blackened the marble, and deſtroyed the phenomenon.

" The building oppoſite to the temple has ſerved as a foundation for a ſquare lofty tower of ordinary maſonry. The columns of the front are walled up; and the entrance is by a low iron gate in the ſide. It is now uſed as a place of confinement for delinquents; but in 1676 was a powder magazine. In the wall of a rampart near it are ſome fragments of exquiſite ſculpture, repreſenting the Athenians fighting with the Amazons. Theſe belong to the freeze, which was then ſtanding. In the ſecond century, when Pauſanias lived, much of the painting was impaired by age, but ſome remained, and the ſubjects were chiefly taken from the Trojan ſtory. The traces are ſince vaniſhed.

" The pediment of the temple of Victory, with that of the oppoſite wing, is deſcribed as remaining in 1676, but on each building a ſquare tower had been erected. One of the ſteps in the front of the propyléa was entire, with the four columns, their entablature and the pediment. The portico, to which the five doorways belonged, conſiſted of a large ſquare room, roof-

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ed with ſlabs of marble, which were laid on two great marble beams, and ſuſtained by four beautiful columns. Theſe were Ionic, the proportions of this order beſt ſuiting that purpoſe, as taller than the Doric; the reaſon it was likewiſe preferred in the pronaos of the temple of Victory. The roof of the propyléa, after ſtanding above 2000 years, was probably deſtroyed, with all the pediments, by the Venetians in 1687, when they battered the caſtle in front, firing red-hot bullets, and took it, but were compelled to reſign it again to the Turks in the following year. The exterior walls, and in particular, a ſide of the temple of Victory, retain many marks of their hoſtilities.

11 Temple of Minerva.

"The chief ornament of the acropolis was the parthenion or great temple of Minerva, a moſt ſuperb and magnificent fabric. The Perſians had burned the edifice, which before occupied the ſite, and was called *hecatompedon*, from its being 100 feet ſquare. The zeal of Pericles and of all the Athenians was exerted in providing a far more ample and glorious reſidence for their favourite goddeſs. The architects were Callicrates and Ictinus; and a treatiſe on the building was written by the latter and Carpion. It was of white marble, of the Doric order, the columns fluted and without baſes, the number in front eight: and adorned with admirable ſculpture. The ſtory of the birth of Minerva was carved in the front pediment; and in the back, her conteſt with Neptune for the country. The beaſts of burden, which had conveyed up the materials, were regarded as ſacred, and recompenſed with paſtures; and one, which had voluntarily headed the train, was maintained during life, without labour, at the public expence.

12 Her ſtatue.

"The ſtatue of Minerva, made for this temple by Phidias, was of ivory, 26 cubits or 39 feet high. It was decked with pure gold to the amount of 44 talents, ſo diſpoſed by the advice of Pericles as to be taken off and weighed if required. The goddeſs was repreſented ſtanding, with her veſtment reaching to her feet. Her helmet had a ſphinx for the creſt, and on the ſides were griffins. The head of Meduſa was on her breaſt-plate. In one hand ſhe held her ſpear, and in the other ſupported an image of Victory about four cubits high. The battle of the Centaurs and Lapithæ was carved on her ſandals; and on her ſhield, which lay at her feet, the war of the gods and giants, and the battle of the Athenians and Amazons. By her ſpear was a ſerpent, in alluſion to the ſtory of Erichthonius; and on the pedeſtal, the birth of Pandora. The Sphinx, the Victory, and Serpent, were accounted eminently wonderful. This image was placed in the temple in the firſt year of the 87th Olympiad, in which the Peloponneſian war began. The gold was ſtripped off by the tyrant Lachares, when Demetrius Poliorcetes compelled him to fly. The ſame plunderer plucked down the golden ſhields in the acropolis, and carried away the golden Victories, with the precious veſſels and ornaments provided for the Panathenæan feſtival.

"The parthenion remained entire for many ages after it was deprived of the goddeſs. The Chriſtians converted it into a church, and the Mahometans into a moſque. It is mentioned in the letters of Cruſius, and miſcalled the *pantheon*, and the *temple of the unknown God*. The Venetians under Koningſmark, when they beſieged the acropolis in 1687, threw a bomb, which demoliſhed the roof, and ſetting fire to ſome powder, did much damage to the fabric. The floor, which is indented, ſtill witneſſes the place of its fall. This was the ſad forerunner of farther deſtruction; the Turks, breaking the ſtones, and applying them to the building of a new moſque, which ſtands within the ruin, or to the repairing of their houſes and the walls of the fortreſs. The vaſt pile of ponderous materials, which lay ready, is greatly diminiſhed; the whole ſtructure will gradually be conſumed and diſappear.

13 Temple converted into a moſque.

"The temple of Minerva in 1676 was, as Wheeler and Spon aſſert, the fineſt moſque in the world, without compariſon. The Greeks had adapted the fabric to their ceremonial by conſtructing at one end a ſemicircular receſs for the holy tables, with a window: for before it was enlightened only by the door, obſcurity being preferred under the heathen ritual, except on feſtivals, when it yielded to ſplendid illuminations; the reaſon, it has been ſurmiſed, why temples are commonly found ſimple and unadorned on the inſides. In the wall beneath the window were inſerted two pieces of the ſtone called *phengites*, a ſpecies of marble diſcovered in Cappadocia in the time of Nero; and ſo tranſparent that he erected with it a temple to Fortune, which was luminous within, when the door was ſhut. Theſe pieces were perforated, and the light which entered was tinged with a reddiſh or yellowiſh hue. The picture of the Panagia or Virgin Mary, in Moſaic, on the ceiling of the receſs, remained; with two jaſper columns belonging to the ſcreen, which had ſeparated that part from the nave; and within, a canopy ſupported by four pillars of porphyry, with Corinthian capitals of white marble, under which the table had been placed; and behind it, beneath the window, a marble chair for the archbiſhop; and alſo a pulpit, ſtanding on four ſmall pillars in the middle aile. The Turks had white-waſhed the walls to obliterate the portraits of ſaints, and the other paintings, with which the Greeks decorate their places of worſhip; and had erected a pulpit on the right hand for their iman or reader. The roof was diſpoſed in ſquare compartments; the ſtones maſſive: and ſome had fallen in. It had been ſuſtained in the pronaos by ſix columns; but the place of one was then ſupplied by a large pile of rude maſonry, the Turks not having been able to fill up the gap more worthily. The roof of the naos was ſupported by colonnades ranging with the door, and on each ſide; conſiſting of 22 pillars below, and of 23 above. The odd one was over the entrance, which by that diſpoſition was left wide and unembarraſſed. In the portico were ſuſpended a few lamps, to be uſed in the moſque at the ſeaſons when the muſſelmans aſſemble before day-break, or to be lighted up round the minaret, as is the cuſtom during their Ramazan or Lent.

14 Magnificent ruin.

"It is not eaſy to conceive a more ſtriking object than the parthenion, though now a mere ruin. The columns within the naos have all been removed: but on the floor may be ſeen the circles which directed the workmen in placing them; and at the farther end is a groove acroſs it, as for one of the partitions of the cell. The receſs erected by the Chriſtians is demoliſhed; and from the rubbiſh of the ceiling the Turkiſh boys

Athens. boys collect bits of the Moſaic, of different colours, which compoſed the picture. We are told at Smyrna, that this ſubſtance had taken a poliſh, and been ſet in buckles. This cell is about half demoliſhed; and in the columns which ſurround it, is a large gap near the middle. On the walls are ſome traces of the paintings. Before the portico is a reſervoir ſunk in the rock, to ſupply the Turks with water for the purifications cuſtomary on entering their moſques. In it, on the left hand, is the rubbiſh of the pile erected to ſupply the place of a column; and on the right, a ſtaircaſe, which leads out on the architrave, and has a marble or two with inſcriptions, but worn ſo as not to be legible. It belonged to the minaret, which has been deſtroyed.

15 Sculptures. "The travellers, to whom we are indebted for an account of the moſque, have likewiſe given a deſcription of the ſculpture then remaining in the front. In the middle of the pediment was ſeen a bearded Jupiter, with a majeſtic countenance, ſtanding, and naked; the right arm broken. The thunderbolt, it has been ſuppoſed, was placed in that hand, and the eagle between his feet. On his right was a figure, it is conjectured, of Victory, clothed to the mid-leg; the head and arms gone. This was leading on the horſes of a car, in which Minerva ſat, young and unarmed; her head-dreſs, inſtead of a helmet, reſembling that of a Venus. The generous ardour and lively ſpirit viſible in this pair of celeſtial ſteeds, was ſuch as beſpoke the hand of a maſter, bold and delicate, of a Phidias or Praxiteles. Behind Minerva was a female figure, without a head, ſitting, with an infant in her lap; and in this angle of the pediment was the emperor Hadrian with his arm round Sabina, both reclining, and ſeeming to regard Minerva with pleaſure. On the left ſide of Jupiter were five or ſix other trunks to complete the aſſembly of deities, into which he received her. Theſe figures were all wonderfully carved, and appeared as big as life. Hadrian and his conſort, it is likely, were complimented by the Athenians with places among the marble gods in the pediment, as benefactors. Both of them may be conſidered as intruders on the original company; and poſſibly their heads were placed on trunks, which before had other owners. They ſtill poſſeſs their corner, and are eaſy to be recogniſed, though not unimpaired. The reſt of the ſtatues are defaced, removed, or fallen. Moroſini was ambitious to enrich Vence with the ſpoils of Athens; and by an attempt to take down the principal group, haſtened their ruin. In the other pediment is a head or two of ſea-horſes finely executed, with ſome mutilated figures; and on the architrave beneath them are marks of the fixtures of votive offerings, perhaps of the golden ſhields, or of feſtoons ſuſpended on ſolemn occaſions, when the temple was dreſſed out to receive the votaries of the goddeſs.

16 Erectheum "Neptune and Minerva, once rival deities, were joint and amicable tenants of the Erecthéum, in which was an altar of Oblivion. The building was double, a partition-wall dividing it into two temples, which fronted different ways. One was the temple of Neptune Erectheus, the other of Minerva Polias. The latter was entered by a ſquare portico connected with a marble ſkreen, which fronts towards the propyléa. The door of the cell was on the left hand; and at the farther end of the paſſage was a door leading down into the Pandroſéum, which was contiguous.

17 Temple of Neptune Erectheus. "Before the temple of Neptune Erectheus was an altar of Jupiter *the ſupreme*, on which no living thing was ſacrificed, but they offered cakes without wine. Within it was the altar of Neptune and Erectheus; and two, belonging to Vulcan and a hero named *Butes*, who had tranſmitted the prieſthood to his poſterity, which were called *Butadæ*. On the walls were paintings of this illuſtrious family, from which the prieſteſs of Minerva Polias was alſo taken. It was aſſerted that Neptune had ordained the well of ſalt water, and the figure of a trident in the rock, to be memorials of his contending for the country. The former, Pauſanias remarks, was no great wonder, for other wells of a ſimilar nature were found inland; but this, when the ſouth wind blew, afforded the ſound of waves.

18 Of Minerva Polias. "The temple of Minerva Polias was dedicated by all Attica, and poſſeſſed the moſt ancient ſtatue of the goddeſs. The demi or towns had other deities, but their zeal for her ſuffered no diminution. The image, which they placed in the acropolis, then the city, was in after ages not only reputed conſummately holy, but believed to have fallen down from heaven in the reign of Erichthonius. It was guarded by a large ſerpent, which was regularly ſerved with offerings of honied cakes for his food. This divine reptile was of great ſagacity, and attained to an extraordinary age. He wiſely withdrew from the temple, when in danger from the Medes; and, it is ſaid, was living in the ſecond century. Before this ſtatue was an owl; and a golden lamp. This continued burning day and night. It was contrived by a curious artiſt, named *Callimachus*, and did not require to be repleniſhed with oil oftener than once a-year. A brazen palm-tree, reaching to the roof, received its ſmoke. Ariſtion had let the holy flame expire while Sylla beſieged him, and was abhorred for his impiety. The original olive-tree, ſaid to have been produced by Minerva, was kept in this temple. When the Medes ſet fire to the acropolis, it was conſumed; but, they aſſerted, on the following day, was found to have ſhot up again as much as a cubit. It grew low and crooked, but was eſteemed very holy. The prieſteſs of Minerva was not allowed to eat of the new cheeſe of Attica; and, among her perquiſites, was a meaſure of wheat, and one of barley, for every birth and burial. This temple was again burned when Callias was archon, 24 years after the death of Pericles. Near it was the tomb of Cecrops, and within it Erectheus was buried.

"The ruin of the Erecthéum is of white marble; the architectural ornaments of very exquiſite workmanſhip, and uncommonly curious. The columns of the front of the temple of Neptune are ſtanding with the architrave; and alſo the ſkreen and portico of Minerva Polias, with a portion of the cell retaining traces of the partition-wall. The order is Ionic. An edifice revered by ancient Attica, as holy in the higheſt degree, was in 1676 the dwelling of a Turkiſh family, and is now deſerted and neglected; but many ponderous ſtones and much rubbiſh muſt be removed before the well and trident would appear. The former, at leaſt, might probably be diſcovered. The portico is uſed as a powder-magazine; but we obtained permiſ-

Athens.

fion to dig and to examine the outfide. The door-way of the veftibule is walled up, and the foil rifen nearly to the top of the door-way of the Pandroféum. By the portico is a battery commanding the town, from which afcends an amufing hum. The Turks fire from it, to give notice of the commencement of Ramazan or of their Lent, and of bairam or the holy-days, and on other public occafions.

"The pandroféum is a fmall, but very particular building, of which no fatisfactory idea can be communicated by defcription. The entablature is fupported by women called *Caryatides*. Their ftory is thus related. The Greeks, victorious in the Perfian war, jointly deftroyed Carya, a city of the Peloponnefus, which had favoured the common enemy. They cut off the males, and carried into captivity the women, whom they compelled to retain their former drefs and ornaments, though in a ftate of fervitude. The architects of thofe times, to perpetuate the memory of their punifhment, reprefented them, as in this inftance, each with a burden on her head, one hand uplifted to it; and the other hanging down by her fide. The images were in number fix, all looking toward the parthenion. The four in front, with that next to the propyléa, remain, but mutilated, and their faces befmeared with paint. The foil is rifen almoft to the top of the bafement on which they are placed. This temple was open or latticed between the ftatues; and in it alfo was a ftunted olive-tree, with an altar of Jupiter Hercéus ftanding under it. The propyléa are nearly in a line with the fpace dividing it from the parthenion; which difpofition, befides its other effects, occafioned the front and flank of the latter edifice to be feen at once by thofe who approached it from the entrance of the acropolis.

19
Of Jupiter Olympius.

"The ruin of the temple of Jupiter Olympius confifts of prodigious columns, tall and beautiful, of the Corinthian order, fluted; fome fingle, fome fupporting their architraves; with a few maffive marbles beneath; the remnant of a vaft heap, which only many ages could have confumed and reduced into fo fcanty a compafs. The columns are of very extraordinary dimenfions, being about fix feet in diameter, and near 60 in height. The number without the cell was 116 or 120. Seventeen were ftanding in 1676: but a few years before we arrived, one was overturned with much difficulty, and applied to the building a new mofque in the bazar or market-place. This violence was avenged by the bafhaw of Negropont, who made it a pretext for extorting from the vaiwode or governor 15 purfes; the pillar being, he alleged, the property of their mafter the Grand Signior. It was an angular column, and of confequence in determining the dimenfions of the fabric. We regretted that the fall of this mighty mafs had not been poftponed until we came, as it would have afforded an opportunity of infpecting and meafuring fome members which we found far too lofty to be attempted. On a piece of the architrave, fupported by a couple of columns, are two parallel walls, of modern mafonry, arched about the middle, and again near the top. You are told it has been the habitation of a hermit, doubtlefs of a Stylites; but of whatever building it has been part, and for whatever purpofe defigned, it muft have been erected thus high in air, while the immenfe ruin of this huge ftructure was yet fcarcely diminifhed, and the heap inclined fo as to render it acceffible. It was remarked that two ftones of a ftep in the front had coalefced at the extremity, fo that no juncture could be perceived; and the like was difcovered alfo in a ftep of the parthenion. In both inftances it may be attributed to a concretory fluid, which pervades the marble in the quarry. Some portion remaining in the pieces, when taken green as it were, and placed in mutual contact, it exfuded and united them by a procefs fimilar to that in a bone of an animal when broken and properly fet.

Athens, Atherina.

20
Detached pieces of antique fculpture, &c.

"Befides the more ftable antiquities, many detached pieces are found in the town, by the fountains, in the ftreets, the walls, the houfes, and churches. Among thefe are fragments of fculpture; a marble chair or two, which probably belonged to the Gymnafia or theatres: a fun-dial at the catholicon or cathedral, infcribed with the name of the maker; and, at the archiepifcopal houfe clofe by, a very curious veffel of marble, ufed as a ciftern to receive water, but once ferving, it is likely, as a public ftandard or meafure. Many columns occur; with fome maimed ftatues, and pedeftals, feveral with infcriptions, and almoft buried in earth. A cuftom has prevailed, as at Chios, of fixing in the wall, over the gate-ways and doors of the houfes, carved ftones, moft of which exhibit the funeral fupper. In the courts of the houfes lie many round ftelæ, or pillars, once placed on the graves of the Athenians; and a great number are ftill to be feen applied to the fame ufe in the Turkifh burying grounds before the acropolis. Thefe generally have concife infcriptions containing the name of the perfon, and of the town and tribe to which the deceafed belonged. Demetrius the Phalerian, who endeavoured to reftrain fepulchral luxury, enacted, that no perfon fhould have more than one, and that the height fhould not exceed three cubits. Another fpecies, which refembles our modern head-ftones, is fometimes adorned with fculpture, and has an epitaph in verfe. We faw a few mutilated Hermæ. Thefe were bufts on long quadrangular bafes, the heads frequently of brafs, invented by the Athenians. At firft they were made to reprefent only Hermes or Mercury, and defigned as guardians of the fepulchres in which they were lodged; but afterwards the houfes, ftreets, and porticos of Athens, were adorned with them, and rendered venerable by a multitude of portraits of illuftrious men and women, of heroes, and of gods: and, it is related, Hipparchus, fon of Pififtratus, erected them in the demi or borough-towns, and by the road-fide, infcribed with moral apophthegms in elegiac verfe; thus making them vehicles of inftruction."

ATHERINA, in ichthyology, a genus of fifhes of the order of abdominales. The characters of this genus are thefe: The upper jaw is plain: the rays of the branchioftege membrane are fix; and the fide-belt or line fhines like filver. The fpecies are two, viz. 1. The hepfetus, with about 12 rays in the fin next the anus. It is found in the Mediterranean. It is alfo very common in the fea near Southampton, England, where, it is called a *fmelt*. The higheft feafon is from March to the latter end of May, or beginning of June; in which month it fpawns. It never deferts the place; and is conftantly taken except in hard froft. It is alfo found on other coafts of that ifland. The length is above

bove $4\frac{1}{2}$ inches, and the tail is much forked. The fish is semipellucid, covered with scales; the colour silvery, tinged with yellow: beneath the side-line is a row of small black spots. 2. The menidea, with 24 rays in the fin next the anus. This is a very small pellucid fish, with many black points interspersed; it has many teeth in the lips, but none in the tongue or jaws. It is found in the fresh waters of Carolina, and spawns in April.

ATHEROMA, in surgery, a tumor without pain or discoloration of the skin, containing, in a membranous bag, matter resembling pap, intermixed with hard and stony particles. These tumors are easily cured by incision.

ATHERTON, or ATHERSTON, a town of Warwickshire in England, situated on the river Stour, in W. Long. 1. 30. N. Lat. 52. 40. It is a considerable town, and had formerly a monastery; but now is best known by its fair, which is the greatest in England for cheese.

ATHESIS (anc. geog.), a river of the Cisalpine Gaul, which, rising in the Rhetian Alps, in Mount Brenna, in the county of Tirol, runs southwards and washes Tridentum and Verona, which last it divides; and after passing this, bends its course eastwards, in a parallel direction with the Po, and falls into the Adriatic between Fossa Claudia and Philistina: it separated the Euganei, an ancient people, from the Veneti. The people dwelling on it are called *Athesini* (Pliny). Its modern name is the *Adige*.

ATHLETÆ, in antiquity, persons of strength and agility, disciplined to perform in the public games. The word is originally Greek, αθλητης; formed from αθλος, *certamen*, "combat;" whence also αθλον, the prize or reward adjudged the victor.—Under Athletæ were comprehended wrestlers, boxers, runners, leapers, throwers of the disk, and those practised in other exercises exhibited in the Olympic, Pythian, and other solemn sports; for the conquerors wherein there were established prizes.

ATHLETIC HABIT, denotes a strong hale constitution of body. Anciently it signified a full fleshy corpulent state, such as the athletæ endeavoured to arrive at. The athletic habit is esteemed the highest pitch of health: yet is it dangerous, and the next door to disease; since, when the body is no longer capable of being improved, the next alteration must be for the worse. The chief object of the athletic diet, was to obtain a firm, bulky, weighty body; by force of which, more than art and agility, they frequently overpowered their antagonist: hence they fed altogether on dry solid, and viscuous meats. In the earlier days, their chief food was dry figs and cheese, which was called *arida saginatio* ξηρα τροφη, and Αςκησις διαξηρων ισχαδων. Oribasius, or, as others say, Pythagoras, first brought this in disuse, and substituted flesh in lieu thereof. They had a peculiar bread called κολλητια: They exercised, eat, and drank, without ceasing: they were not allowed to leave off eating when satiated, but were obliged to cram on till they could hold no more; by which means they at length acquired a degree of voracity which to us seems incredible, and a strength proportional. Witness what Pausanias relates of the four celebrated athletæ, Polydamus the Thessalian, Milo the Crotonian, Theagenes the Thasian, and Euthymus the Locrian: The second is said to have carried a bull on his back a considerable way, then to have knocked him down with a blow of his fist, and lastly, as some add, devoured him at a meal.

ATHLONE, a town of Westmeath, in Ireland, lying in W. Long. 8. 0. N. Lat. 53. 20. It is situated on both sides of the Shannon, and both parts are united by a strong, high-raised, and well-built bridge, in the middle of which stands a monument, with some figures cut in marble, together with Queen Elizabeth's arms, and some inscriptions declaring the time and the founders of the building. The castle was founded by King John on some land belonging to St Peter's abbey, for which he granted a compensation. It is built on a high-raised round hill, resembling one of the Danish raths or forts. Here were formerly two convents or monasteries. Athlone was formerly strongly fortified, and considered as of very great importance. In the year 1691, a part of the English army under General Ginckle, in the very face of the Irish, who were strongly entrenched on the opposite shore, fording the river, formed, and took possession of the town, not losing more than 50 men in the attack; which is esteemed as bold and successful an enterprise as any recorded in history. There are generally two troops of horse and four companies of foot quartered at Athlone. This town gives the title of *earl* to the family of Ginckle, as a reward for the noble services performed by the General.

ATHOL, the most northern district of Perthshire in Scotland, extending in length 43 miles, and in breadth 30. It is bordered on the north by Badenoch, on the west by Lochaber, on the east and south-east by Mar and Gowrie, on the south by Stratherne and Perth Proper, and on the south-west by Braidalbane. The country is very rough and mountainous, and contains part of the ancient Caledonian forest; but these mountains are interspersed with fruitful vallies. Here are several villages, but no towns of any consideration. The most noted place is Blair Castle, seated on the river Tilt, near its influx into the Gurrey, a pleasant limpid stream that falls into the Tay. This castle belongs to the Duke of Athol, who derives his title from this district, and lives here with great magnificence. In the same neighbourhood we see the pass of Gillicranky, rendered memorable by the battle fought here in the beginning of King William's reign, between that monarch's general M'Kay, and the Highlanders adhering to king James. See GILLICRANKY.

ATHOS, a celebrated mountain of Chalcidia in Macedonia, situated E. Long. 26. 20. N. Lat. 40. 10. The ancients entertained extravagant notions concerning its height. Mela affirmed it to be so high as to reach above the clouds; and Martianus Capellinus, that it was six miles high. It was a received opinion, that the summit of mount Athos was above the middle region of the air, and that it never rained there; because the ashes left on the altars erected near its summit were always found as they were left, dry and unscattered. But if on many accounts it was famous among the ancients, it is no less so among the moderns. The Greeks, struck with its singular situation and the venerable appearance of its towering ascent, erected so many churches, monasteries, hermitages, &c. upon it, that it became in a manner inhabited by devotees, and from thence received the name of the *Holy Mountain*; which name it still retains, though many of those consecrated works are now decayed. According to the accounts of modern travellers, this mountain advances into the Archipelago, being joined to the continent by an isthmus about half a league in breadth. It is about 30 miles in circumference, and two in perpendicular height. It may be tavelled over in about three days, and may be seen 90 miles off. There is a fine prospect from the top; but, like all other high mountains, the cold on its summit is excessive. It abounds with many different kinds of plants and trees, particularly the pine and fir. In the valleys grows a plant called *elegia*, whose branches serve to make pens for writing. In short, this mountain is said to be adorned with variety of herbage and evergreens, a multitude of springs and streams, and woods growing near the shore, so as to be one of the most agreeable places in the world.

It is now inhabited by Caloyers, a sort of Greek monks, of the order of St Basil, who never marry, though others of that church do. They abstain from flesh, and fare very hardly, their ordinary meal being olives pickled when they are ripe. They are about 6000 in all, and inhabit several parts of the mountain, on which are 24 large old monasteries, surrounded with high walls for a defence against banditti. They are so respected, that the Turks themselves will often send them alms. These monks are not idle like others; but labour with the ax, spade, and sickle, dressing themselves like hermits. Formerly they had fine Greek manuscripts; but are now become so illiterate, that they can scarce read or write.

Through this mountain, or rather through the isthmus behind it, Xerxes king of Persia is said to have cut a passage for his fleet when about to invade Greece. In this work he spent three whole years, and employed in it all the forces on board the fleet. He is also said, before the work was begun, to have written the following insolent and ridiculous letter to the mountain: "Athos, thou proud and aspiring mountain, that liftest up thy head to the very skies, I advise thee not to be so audacious as to put rocks and stones that cannot be cut in the way of my workmen. If thou makest that opposition, I will cut thee entirely down, and throw thee headlong into the sea." The directors of this enterprise are said to have been Bubaris the son of Megabyzus, and Artacheus the son of Arbeus, both Persians; but as no traces of such a great work remain, the truth of the whole relation has justly been called in question.

ATHWART, in navigation, is synonimous with across the line of the course.

Athwart the Fore-foot, is a phrase that denotes the flight of a cannon-ball from one ship across the course of another, to intercept the latter, and oblige her to shorten sail, that the former may come near enough to examine her.

Athwart-Hause, expresses the situation of a ship, when she is driven by wind or tide, or any other accident, across the fore-part of another.

Athwart-Ships, reaching across ships from one side to the other.

ATHY, a town of Ireland in the county of Kildare, not far from the borders of Queen's county. W. Long. 7. 0. N. Lat. 53. 0. It is situated on the river Barrow; is governed by a sovereign, two bailiffs, and a recorder, and is, alternately with Naas, the assizes town.

ATIBAR, the name by which the inhabitants of the kingdom of Gago in Africa call gold-dust; from which word Europeans, and especially the French, have composed the word *tibir*, which also signifies gold-dust among those who trade in that commodity.

ATIGNY, an ancient town of Champagne in France, where several of the kings of France had their residence. It is seated on the river Arsne, in E. Long. 4. 47. N. Lat. 49. 30.

ATKINS (Sir Robert), lord chief baron of the exchequer, was born in 1621, and educated at the university of Oxford, from whence he removed to the inns of court, and became eminent in the law. He was made knight of the Bath, with many other persons of the first distinction, at the coronation of King Charles II. In 1672, he was appointed one of the judges of Common Pleas; in which honourable station he continued till 1679, when, foreseeing the troubles that soon after ensued, he thought fit to resign, and retire into the country. In 1689, he was made by King William lord chief baron of the exchequer; and about the same time executed the office of speaker to the house of lords, which had been previously refused by the Marquis of Halifax. He distinguished himself by an unshaken zeal for the laws and liberties of his country. He wrote several pieces, which have been collected into one volume 8vo, under the title of *Parliamentary and Political Tracts*. The authors of the Biographia Britannica remark, that whoever inclines to be thoroughly informed of the true constitution of his country, of the grounds and reasons of the revolution, and of the danger of suffering prerogative to jostle law, cannot read a better or plainer book than those tracts of Sir Robert Atkins. He died in 1709, aged 88.

ATKINS (Sir Robert), son of the preceding, was born in 1646, and was eminent for all the virtues that could adorn an English gentleman. He wrote The Ancient and Present State of Gloucestershire, in one large volume in folio; and died October 29, 1711.

ATKYNS (Richard), was descended from a good family, and was born at Tuffleigh in Gloucestershire, in the year 1615. He was educated at Oxford, from whence he removed to Lincoln's Inn, and afterwards distinguished himself by his loyalty to King Charles I. for whom he raised a troop of horse at his own expence. At the Restoration he was made one of the deputy lieutenants of Gloucestershire, and distinguished himself by his attachment to the government. But at length being committed prisoner to the Marshalsea in Southwark for debt, he died there on the 14th of September 1677. He wrote several pieces, particularly A Treatise on the Original and Growth of Printing.

ATLANTIC OCEAN, that bounded by Europe and Africa on the east, and by America on the west.

ATLANTICA. See ATLANTIS.

ATLANTIDES, in astronomy, a denomination given to the Pleiades, or seven stars, sometimes also called *Vergilliæ*. They are thus called, as being suppo-

sed

sed by the poets to have been the daughters either of Atlas or his brother Hesperus, who were translated into heaven.

ATLANTIS, Atalantis, or Atlantica, an island mentioned by Plato and some others of the ancients, concerning the real existence of which many disputes have been raised. Homer, Horace, and the other poets, make two Atlanticas, calling them *Hesperides* and *Elysian Fields*, making them the habitations of the blessed. The most distinct account of this island we have in Plato's Timæus, of which Mr Chambers gives the following abridgment. "The Atlantis was a large island in the western ocean, situated before or opposite to the straits of Gades. Out of this island there was an easy passage into some others, which lay near a large continent exceeding in bigness all Europe and Asia. Neptune settled in this island (from whose son Atlas its name was derived), and divided it among his ten sons. To the youngest fell the extremity of the island, called *Gadir*, which in the language of the country signifies *fertile*, or *abundant in sheep*. The descendants of Neptune reigned here from father to son for a great number of generations in the order of primogeniture, during the space of 9000 years. They also possessed several other islands; and, passing into Europe and Africa, subdued all Lybia as far as Egypt, and all Europe to Asia Minor. At length the island sunk under water, and for a long time afterwards the sea thereabouts was full of rocks and shelves."

Many of the moderns also are of opinion, that the existence of the Atlantis is not to be looked upon as entirely fabulous. Some take it to have been America; and from thence, as well as from a passage in Seneca's Medea, and some other obscure hints, they imagine that the new world was not unknown to the ancients. But allowing this to be the case, the abovementioned continent which was said to lie beyond Atlantis would seem rather to have been the continent of America than Atlantis itself. The learned Rudbeck, professor in the university of Upsal, in a work intitled *Atlantica sive Manheim*, endeavours to prove that Sweden and Norway are the Atlantis of the ancients; but this its situation will by no means allow us to believe. By Kircher it is supposed to have been an island extending from the Canaries quite to the Azores; that it was really swallowed up by the ocean as Plato asserts: and that these small islands are the shattered remains of it which were left standing.

Atlantis (New), is the name of a fictitious philosophical commonwealth, of which a description has been given by Lord Bacon.—The new Atlantis is supposed to be an island in the South Sea, to which the author was driven in a voyage from Peru to Japan. The composition is an ingenious fable, formed after the manner of the Utopia of Sir Thomas More, or Campanella's City of the Sun. Its chief design is to exhibit a model or description of a college, instituted for the interpretation of nature and the production of great and marvellous works, for the benefit of men, under the name of *Solomon's House*, or "the college of the six day's work." Thus much, at least, is finished; and with great beauty and magnificence. The author proposed also a frame of laws, or of the best state or mould of a commonwealth. But this part is not executed.

ATLAS, king of Mauritania, a great astronomer, contemporary with Moses. From his taking observations of the stars from a mountain, the poets feigned him to have been turned into a mountain, and to sustain the heavens on his shoulders. Being an excellent astronomer, and the first who taught the doctrine of the sphere, they tell us that his daughters were turned into stars; seven of them forming the Pleiades, and other seven the Hyades.

Atlas, a chain of mountains in Africa, lying between the 20th and 25th degree of north latitude, and supposed almost to divide the continent from east to west. They are said to have derived their name from Atlas king of Mauritania, who was a great astronomer. They are greatly celebrated by the ancients on account of their height, insomuch that the abovementioned king, who is said to have been transformed into a mountain, was feigned to bear up the heavens on his shoulders. We are assured, however, by Dr Shaw, that the part of this chain of mountains which fell under his observation could not stand in competition either with the Alps or Apennines. He tells us, that if we conceive a number of hills, usually of the perpendicular height of 400, 500, or 600 yards, with an easy ascent, and several groves of fruit or forest trees, rising up in a succession of ranges above one another; and that if to this prospect we add now and then a rocky precipice, and on the summit of each imagine a miserable mud-walled village; we shall then have a just idea of the mountains of Atlas.

According to M. Chenier*, this mountain is formed by an endless chain of lofty eminences, divided into different countries, inhabited by a multitude of tribes, whose ferocity permits no stranger to approach. "I have not been able (continues he) to obtain a sufficient knowledge of these mountains to describe them accurately: What Leo Africanus has said of them is very vague; and his account is the less to be regarded at present, as it is now about three centuries since he wrote, and the face of the country has been in that time totally changed. Nothing perhaps would be more interesting to the curiosity of the philosopher, or conduce more to the improvement of our knowledge in natural history, than a journey over mount Atlas. The climate, though extremely cold in winter, is very healthy and pleasant; the valleys are well cultivated, abound in fruits, and are diversified by forests and plentiful springs, the streams of which uniting at a little distance, form great rivers, and lose themselves in the ocean. According to the reports of the Moors, there are many quarries of marble, granite, and other valuable stone, in these mountains: It is probable there are also mines, but the inhabitants have no idea of these riches; they consider their liberty, which their situation enables them to defend, as the most inestimable of all treasures."

* *Hist. of Morocco*, l. 13.

Atlas, in matters of literature, denotes a book of universal geography, containing maps of all the known parts of the world.

Atlas, in commerce, a silk-sattin, manufactured in the East-Indies. There are some plain, some striped, and some flowered, the flowers of which are either gold or only silk. There are atlasses of all colours; but most of them false, especially the red and the crimson. The manufacture of them is admirable; the gold and

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and silk being worked together after such a manner as no workmen in Europe can imitate; yet they are very far from having that fine gloss and lustre which the French know how to give to their silk stuffs. In the Chinese manufactures of this sort, they gild paper on one side with leaf-gold; then cut it in long slips, and weave it into their silks; which makes them with very little cost, look very rich and fine. The same long slips are twisted or turned about silk threads, so artificially, as to look finer than gold thread, though it be of no great value.

ATMOSPHERE, a word generally used to signify the whole mass of fluid consisting of air, aqueous and other vapours, electric fluid, &c. surrounding the earth to a considerable height.

1 Atmosphere composed of two different fluids.

The composition of that part of our atmosphere properly called *air*, was till lately very much unknown. In former times it was supposed to be a simple, homogeneous, and elementary fluid. The experiments of Dr Priestly discovered, that the purest kind of air, which he called *dephlogisticated*, was in reality a compound, and might be artificially produced in various ways. His first conjectures concerning its component parts were, that it consisted of earth, nitrous acid, and phlogiston. Subsequent experiments rendered these conjectures dubious; and at last it was supposed that dephlogisticated air is a pure elementary substance, the vivifying principle to animals, and the acidifying principle throughout all nature. This dephlogisticated air, however, is but a small part of the composition of our atmosphere. According to the most accurate computations, the air we usually breathe is composed of only one-fourth of this dephlogisticated air, or perhaps less; the other three or four parts consisting of what Dr Priestley calls *phlogisticated*, and M. Lavoisier *mephitic air*. This by itself is absolutely noxious, and exceedingly poisonous to animals: though it seems only to be negatively so; for when mixed in a certain proportion with dephlogisticated air, it may be breathed with safety, which could not be if it contained any ingredient absolutely unfriendly to the human constitution. The other part, viz. the pure dephlogisticated air, seems to stand much in the same relation to plants that phlogisticated air does to animals; that is, it would prove poisonous, and destroy them if they were to depend upon it entirely for their subsistence; but as they derive their nourishment partly from the air and partly from the soil, it thence happens, that the plants which are set to grow in dephlogisticated air do not die instantly, as animals do in the phlogisticated kind, but remain for some time weak and sickly.

2 Phlogisticated air poisonous to animals, and dephlogisticated air to vegetables.

3 A great quantity of electric fluid contained in the atmosphere

The other component parts of our atmosphere are so various, and of such heterogeneous natures, that they do not admit of any kind of definition or analysis, one only excepted, namely, the *electric fluid*. This we know pervades the whole, but appears to be much more copious in the upper than in the lower atmospherical regions. See Electricity. To measure the absolute quantity of this fluid, either in the atmosphere or any other substance, is impossible. All that we can know on this subject is, that the electric fluid pervades the atmosphere; that it appears to be more abundant in the superior than the inferior regions; that it seems to be the immediate bond of connection between the atmosphere and the water which is suspended in it; and that by its various operations, the phenomena of hail, rain, snow, lightning, and various other kinds of meteors, are occasioned. See Rain, Hail, Snow, &c.

4 Calculations of the height of the atmosphere.

Various attempts have been made to ascertain the height to which the atmosphere is extended all round the earth. These commenced soon after it was discovered, by means of the Torricellian tube, that air is a gravitating substance. Thus it also became known, that a column of air, whose base is a square inch, and the height that of the whole atmosphere, weighs 15 pounds; and that the weight of air is to that of mercury as 1 to 10,800: whence it follows, that if the weight of the atmosphere be sufficient to raise a column of mercury to the height of 30 inches, the height of the aerial column must be 10,800 times as much, and consequently a little more than five miles high.

It was not, however, at any time supposed, that this calculation could be just: for as the air is an elastic fluid, the upper parts must expand to an immense bulk, and thus render the calculation above related exceedingly erroneous. By experiments made in different countries, it has been found, that the spaces which any portion of air takes up, are reciprocally proportional to the weights with which it is compressed. Allowances were therefore to be made in calculating the height of the atmosphere. If we suppose the height of the whole divided into innumerable equal parts, the density of each of which is as its quantity; and the weight of the whole incumbent atmosphere being also as its quantity; it is evident, that the weight of the incumbent air is every where as the quantity contained in the subjacent part; which makes a difference between the weights of each two contiguous parts of air. By a theorem in geometry, where the differences of magnitudes are geometrically proportional to the magnitudes themselves, these magnitudes are in continual arithmetical proportion; therefore, if, according to the supposition, the altitude of the air, by the addition of new parts into which it is divided, do continually increase in arithmetical proportion, its density will be diminished, or (which is the same thing, its gravity decreased) in continual geometrical proportion.

It is now easy, from such a series, by making two or three barometrical observations, and determining the density of the atmosphere at two or three different stations, to determine its absolute height, or its rarity at any assignable height. Calculations accordingly were made upon this plan; but it having been found that the barometrical observations by no means corresponded with the density which, by other experiments, the air ought to have had, it was suspected that the upper part of the atmospherical regions were not subject to the same laws with the lower ones. Philosophers therefore had recourse to another method for determining the altitude of the atmosphere, viz. by a calculation of the height from which the light of the sun is refracted, so as to become visible to us before he himself is seen in the heavens. By this method it was determined, that at the height of 45 miles the atmosphere had no power of refraction; and consequently beyond that distance was either a mere vacuum, or the next thing to it, and not to be regarded.

5 Height of it determined from the beginning and end of twilight.

This theory soon became very generally received and the height of the atmosphere was spoken of as familiarly

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6 Objection from the appearance of meteors.

miliarly as the height of a mountain, and reckoned to be as well ascertained, if not more so, than the heights of most mountains are. Very great objections, however, which have never yet been removed, arise from the appearances of some *meteors*, like large globes of fire, not unfrequently to be seen at vast heights above the earth (see METEOR). A very remarkable one of this kind was observed by Dr Halley in the month of March 1719, whose altitude he computed to have been between 69 and 73¼ English miles; its diameter 2800 yards, or upwards of a mile and an half; and its velocity about 350 miles in a minute. Others, apparently of the same kind, but whose altitude and velocity were still greater, have been observed: particularly that very remarkable one, August 18th 1781, whose distance from the earth could not be less than 90 miles, and its diameter not less than the former; at the same time that its velocity was certainly not less than 1000 miles in a minute. Fire-balls, in appearance similar to these, though vastly inferior in size, have been sometimes observed at the surface of the earth. Of this kind Dr Priestley mentions one seen on board the Montague, 4th November 1749, which appeared as big as a large millstone, and broke with a violent explosion.

From analogical reasoning, it seems very probable, that the meteors which appear at such great heights in the air are not essentially different from those which, like the fire-ball just mentioned, are met with on the surface of the earth. The perplexing circumstances with regard to the former are, that at the great heights abovementioned, the atmosphere ought not to have any density sufficient to support flame, or to propagate sound; yet these meteors are commonly succeeded by one or more explosions, nay are sometimes said to be accompanied with a hissing noise as they pass over our heads. The meteor of 1719 was not only very bright, insomuch that for a short space it turned night into day, but was attended with an explosion heard over all the island of Britain, occasioning a violent concussion in the atmosphere, and seeming to shake the earth itself. That of 1783 also, though much higher than the former, was succeeded by explosions; and, according to the testimony of several people, a hissing noise was heard as it passed. Dr Halley acknowledged that he was unable to reconcile these circumstances with the received theory of the height of the atmosphere; as, in the regions in which this meteor moved, the air ought to have been 300,000 times more rare than what we breathe, and the next thing to a perfect vacuum.

In the meteor of 1783, the difficulty is still greater, as it appears to have been 20 miles farther up in the air. Dr Halley offers a conjecture, indeed, that the vast magnitude of such bodies might compensate for the thinness of the medium in which they moved. Whether or not this was the case, cannot indeed be ascertained, as we have so few data to go upon; but the greatest difficulty is to account for the brightness of the light. Appearances of this kind are indeed with great probability attributed to electricity, but the difficulty is not thus removed. Though the electrical fire pervades with great ease the vacuum of a common air-pump, yet it does not in that case appear in bright well defined sparks, as in the open air, but rather in long streams resembling the aurora borealis. From some late experiments indeed, Mr Morgan concludes, that the electrical fluid cannot penetrate a perfect vacuum*. If this is the case, it shows that the regions we speak of are not such a perfect vacuum as can be artificially made; but whether it is or not, the extreme brightness of the light shows that a fluid was present in those regions, capable of confining and condensing the electric matter as much as the air does at the surface of the ground; for the brightness of these meteors, considering their distance, cannot be supposed inferior to that of the brightest flashes of lightning.

* See *Electricity*-Index.

7 Density of the air does not always keep pace with its gravity.

This being the case, it appears reasonable to conclude that what is called the *density* of the air does not altogether keep pace with its gravity. The latter indeed must in a great measure be affected by the vapours, but above all by the quantity of the basis of fixed or dephlogisticated air contained in it: for Mr Kirwan has discovered that the basis of fixed air, when deprived of its elastic principle, is not greatly inferior to gold in specific gravity; and we cannot suppose that of dephlogisticated air to be much less. It is possible, therefore, that pure air, could it be deprived of all the water it contains, might have very little gravity; and as there is great reason to believe that the basis of dephlogisticated air is only one of the constituent parts of water †, we see an evident reason why the air ought to become lighter, and likewise less fit for respiration, the higher up we go, though there is a possibility that its density, or power of supporting flame, may continue unaltered.

† See *Dephlogisticated air*, and *Water*.

There are not yet, however, a sufficient number of facts to enable us to determine this question; though such as have been discovered seem rather to favour the above conjecture. Dr Boerhaave was of opinion that the gravity of the air depended entirely on the water it contained; and, by means of alkaline salts, he was enabled to extract as much water from a quantity of air as was very nearly equivalent to its weight. By the calcination of metals we may extract as much of the basis of dephlogisticated air from a quantity of atmospherical air as is equivalent to the weight of air lost. Were it possible, therefore, to extract the whole of this, as well as all other vapours, and to preserve only the elastic principle, it is highly probable that its gravity would entirely cease. It has been found by those who have ascended with aerostatic machines, or to the tops of high mountains, that the deplogisticated air is found to be contained in smaller quantities in the atmosphere of these elevated regions than on the lower grounds. It is also found, that in such situations the air is much drier, and parts with water with much more difficulty, than on the ordinary surface. Salt of tartar, for instance, which at the foot of a mountain will very soon run into a liquid, remains for a long time exposed to the air on the top of it, without showing the least tendency to deliquesce. Nevertheless, it hath never been observed that fires did not burn as intensely on the tops of the highest monntains as on the plains. The matter indeed was put to the trial in the great eruption of Vesuvius in 1779, where, though the lava spouted up to the height of three miles above the level of the sea, the uppermost parts all the while were to appearance as much inflamed as the lowest.

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8 Gravity of the upper regions of the atmosphere perhaps diminished by electricity.

The high degree of electricity, always existing in the upper regions of the atmosphere, must of necessity have a very considerable influence on the gravity of any heterogeneous particles floating in it. When we consider the effects of the electric fluid upon light bodies at the surface of the earth, it will readily be admitted, that in those regions where this fluid is very abundant, the gravity of the atmosphere may be much diminished without affecting its density. We know that it is the nature of any electrified substance to attract light bodies; and that, by proper management, they may even be suspended in the air, without either moving up or down for a considerable time. If this is the case with light terrestrial bodies it cannot be thought very improbable that the aerial particles themselves, *i. e.* those which we call the basis of dephlogisticated air, and of aqueous or other vapour diffused among them, should be thus affected in the regions where electricity is so abundant. From this cause, therefore, also the gravity of the atmosphere may be affected without any alteration at all being made in its density; and hence may arise anomalies in the barometer hitherto not taken notice of.

9 Absolute height of the atmosphere undetermined

It appears, therefore, that the absolute height of the atmosphere is not yet determined. The beginning and ending of twilight indeed show, that the height at which the atmosphere begins to refract the sun's light is about 44 or 45 English miles. But this may not improbably be only the height to which the aqueous vapours are carried: for it cannot be thought any unreasonable supposition, that light is refracted only by means of the aqueous vapour contained in the atmosphere; and that where this ceases, it is still capable of supporting the *electric* fire at least, as bright and strong as at the surface. That it does extend much higher, is evident from the meteors already mentioned: for all these are undoubtedly carried along with the atmosphere; otherwise that of 1783, which was seen for about a minute, must have been left 1000 miles to the westward, by the earth flying out below it in its annual course round the sun.

10 Of the pressure of the atmosphere

It has already been mentioned, that the pressure of the atmosphere, when in its mean state, is equivalent to a weight of 15 pounds on every square inch. Hence Dr Cotes computed, that the pressure of the whole ambient fluid upon the earth's surface is equivalent to that of a globe of lead 60 miles in diameter. Hence also it appears, that the pressure upon a human body must be very considerable; for as every square inch of surface sustains a pressure of 15 pounds, every square foot, as containing 144 inches, must sustain a pressure of 2160; and if we suppose a man's body to contain 15 square feet of surface, which is pretty near the truth, he must sustain a weight of 32,400 pounds, or 16 tun, for his ordinary load. By this enormous pressure we should undoubtedly be crushed in a moment, were not all parts of our bodies filled either with air or some other elastic fluid, the spring of which is just sufficient to counterbalance the weight of the atmosphere. But whatever this fluid may be, we are sure that it is just able to counteract the atmospherical gravity and no more; for if any considerable pressure be superadded to that of the air, as by going into deep water, or the like, it is always severely felt, let it be ever so equable. If the pressure of the atmosphere is taken off from any part of the human body, the hand, for instance, when put in an open receiver from whence the air is afterwards extracted, the weight of the atmosphere then discovers itself, and we imagine the hand strongly sucked down into the glass. See PNEUMATICS.

11 Variation of the pressure, and its effects.

In countries at some distance from the equator, the pressure of the atmosphere varies considerably, and thus produces considerable changes on many terrestrial bodies. On the human body the quantity of pressure sometimes varies near a whole tun; and when it is thus so much diminished, most people find something of a listlessness and inactivity about them. It is surprising, however, that the spring of the internal fluid, already mentioned, which acts as a counterpoise to the atmospherical gravity, should in all cases seem to keep pace with it when the pressure is naturally diminished, and even when it is artificially augmented, though not when the pressure is artificially diminished. Thus in that kind of weather when the pressure of the air is least, we never perceive our veins to swell, or are sensible of any inward expansion in our bodies. On the contrary, the circulation is languid, and we seem rather to be oppressed by a weight.

12 Of difficulty of respiration on the tops of mountains.

Even in going up to the tops of mountains, where the pressure in the atmosphere is diminished more than three times what it usually is on the plain, no such appearances are observed. Some travellers indeed have affirmed, that, on the tops of very high mountains, the air is so light as to occasion a great difficulty of respiration, and even violent retching and vomiting of blood. It does not appear, however, that these assertions are well founded. Mr Brydone found no inconvenience of this kind on the top of mount Ætna; nor is any such thing mentioned by Mr Houel, who also ascended this mountain. Sir William Hamilton indeed says, that he did feel a difficulty of respiration, independent of any sulphureous stream. But, on the top of a volcano, the respiration may be affected by so many different causes, that it is perhaps impossible to assign the true one. The French mathematicians, when on the top of a very high peak of the Andes, did not make any complaint of this kind, though they lived there for some time. On the contrary, they found the wind so extremely violent, that they were scarce able to withstand its force; which seems an argument for at least equal *density* of the atmosphere in the superior as in the inferior regions. Dr Heberden, who ascended to the top of Teneriffe, a higher mountain than Ætna, makes no mention of any difficulty of respiration.

13 Mr Saussure's symptoms on the top of Mount Blanc accounted for

M. Saussure, however, in his journey to the top of Mount Blanc, the highest of the Alps, felt very great uneasiness in the way. His respiration was not only extremely difficult, but his pulse became quick, and he was seized with all the symptoms of a fever. His strength was also exhausted to such a degree, that he seemed to require four times as long a space to perform some experiments on the top of the mountain as he would have done at the foot of it. It must be observed, however, that these symptoms did not begin to appear till he had ascended two miles and a half perpendicular above the level of the sea. The mountain is only about a quarter of a mile higher; and in this short space he was reduced to the situation just mentioned. But it is improbable that so small a difference, even at the end of of his journey, ſhould have produced ſuch violent effects, had not ſome other cauſe concurred. A cauſe of this kind he himſelf mentions, viz. that the atmoſphere at the top of the mountain was ſo much impregnated with fixed air, that lime-water, expoſed to it, quickly became covered with a pellicle occaſioned by the abſorption of that fluid. Now it is known, that fixed air is extremely pernicious to animals, and would bring on ſymptoms ſimilar to thoſe abovementioned. There is no reaſon, therefore, to have recourſe to the rarity of the atmoſphere for ſolving a phenomenon which may more naturally be accounted for otherwiſe.

When the preſſure of the atmoſphere is augmented, by deſcending, in the diving-bell, to conſiderable depths in the ſea, it does not appear that any inconvenience follows from its increaſe. Thoſe who ſit in the diving-bell are not ſenſible of any preſſure as long as they remain in the air, though they feel it very ſenſibly in going into the water: yet it is certain, that the preſſure in both caſes is the ſame; for the whole preſſure of the atmoſphere, as well as of the water, is ſuſtained by the air in the diving-bell, and conſequently communicated to thoſe who ſit in it.

But though artificial compreſſion of the air, as well as natural rarefaction, can thus be borne, it is otherwiſe with artificial rarefaction. Animals in an air-pump ſhow uneaſineſs from the very firſt, and cannot live for any time in an atmoſphere rarefied artificially even as much as it appeared to be from the barometer on the top of Mount Blanc.

14
Variation of the atmoſpherical preſſure accounted for.

It is not eaſy to aſſign the true reaſon of the variations of gravity in the atmoſphere. Certain it is, however, that they take place only in a very ſmall degree within the tropics; and ſeem there to depend on the heat of the ſun, as the barometer conſtantly ſinks near half an inch every day, and riſes again to its former ſtation in the night-time. In the temperate zones the barometer ranges from 28 to near 31 inches, by its various altitudes ſhowing the changes that are about to take place in the weather. If we could know, therefore, the latent cauſes by which the weather is influenced, we ſhould likewiſe certainly know thoſe by which the gravity of the atmoſphere is affected. Theſe are particularly explained under the articles Rain, Hail, Snow, Winds, &c. but in general they may be reduced to two, viz. an emiſſion of latent heat from the vapour contained in the atmoſphere, or of electric fluid from the ſame, or from the earth. To one or both of theſe cauſes, therefore, may we aſcribe the variations of the gravity of the atmoſphere: and we ſee that they both tend to produce the ſame effect with the ſolar heat in the tropical climates, viz. to rarefy the air, by mixing with it or ſetting looſe a non-gravitating fluid, which did not act in ſuch large proportion in any particular place before. No doubt, the action of the latent heat and electric fluid is the ſame in the torrid as in the temperate zones: but in the torrid zone the ſolar heat and exceſſive evaporation counteract them; ſo that whatever quantities may be diſcharged by the exceſſive deluges of rain, &c. which fall in thoſe countries, they are inſtantly abſorbed by the abundant fluid, and are quickly ready to be diſcharged again; while, in the temperate zones, the air becomes ſenſibly lighter, as well as warmer, by them for ſome time before they can be abſorbed again.

15
Variation of the heat and cold of the atmoſphere.

The variations of heat and cold to which the atmoſphere is ſubject, have been the ſubject of much ſpeculation. In general they ſeem to depend entirely upon the light of the ſun reflected into the atmoſphere from the earth; and where this reflection is deficient, even though the light ſhould be preſent ever ſo much, the moſt violent degrees of cold are found to take place. Hence, on the tops of mountains, the cold is generally exceſſive, though by reaſon of the clearneſs of the atmoſphere the light of the ſun falls upon them in greater quantity than it can do on an equal ſpace on the plain. In long winding paſſages alſo, ſuch as the caverns of Ætna and Veſuvius, where the air has room to circulate freely, without any acceſs of the ſun, the cold is ſcarce tolerable; whence the uſe of theſe for cooling liquors, preſerving meat, &c.

16
Lambert and De Luc's reaſons for the cold on the tops of mountains.

The coldneſs of the atmoſphere on the tops of mountains has been aſcribed by M. Lambert and De Luc, to the igneous fluid, or elementary fire, being more rare in thoſe elevated ſituations than on the plains. M. Lambert is of opinion that it is rarefied above by the action of the air, and that below it is condenſed by its own proper weight. He conſiders fire as a fluid in motion, the parts of which are ſeparable, and which is rarefied when its velocity is accelerated. He does not decide with regard to the identity of fire and light, though he ſeems inclined to believe it. M. de Luc compares elementary fire to a continuous fluid, whoſe parts are condenſed by being mutually compreſſed. He denies that fire and light are the ſame; and maintains that the latter is incapable, by itſelf, of ſetting fire to bodies, though it does ſo by putting in motion the igneous fluid they contain; and that it acts with more force near the earth than at a diſtance from its ſurface, by reaſon of this fluid, which he calls an *heavy* and *elaſtic* one, being more condenſed there than at a greater height.

17
Mr Sauſſure's account.

Mr Sauſſure, in treating of this ſubject in his account of the Alps, does not conſider fire as a fluid ſo free and detached as to be able either to aſcend with rapidity by its ſpecific levity, or to condenſe itſelf ſenſibly by its proper weight. He ſuppoſes it to be united to bodies by ſo ſtrict an affinity, that all its motions are determined, or at leaſt powerfully modified, by that affinity. As ſoon therefore as fire, diſengaged by combuſtion or by any other cauſe, endeavours to diffuſe itſelf, all the bodies that come within the ſphere of its activity endeavour to attract it; and they abſorb ſuch quantities of it as are in the direct ratio of their affinities with it, or in the inverſe ratio of what is neceſſary for their equilibrium with the ſurrounding bodies. Now it does not appear that in this diſtribution the ſituation of places, with regard to the horizon, has any other influence than what they receive from the different currents produced by the dilatation of the air, and by the levity which that dilatation produces. The aſcent of flame, ſmoke, &c. or of air heated in any way, perſuaded the ancients that fire is poſſeſſed of abſolute levity, by which it had a tendency to mount upwards. "But theſe effects (ſays he) are owing either to the levity of the fluid which conſtitutes flame, or to that of air dilated by heat; and not to the levity of the igne-

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igneous fluid. I am, however, sufficiently convinced, that this fluid is incomparably lighter than air, though I do not believe that it possesses the power of ascending in our atmosphere by virtue of its levity alone.

18 Mr Bouguer's reasons for the cold on the top of the Andes.

"The celebrated Bouguer has demonstrated, by principles the most simple, and most universally adopted, that it is not necessary, in order to account for the diminution of heat on mountains, to have recourse to hypotheses that are at best doubtful. The following is his explanation of what was felt on the mountains of Peru.

"It was proper, in order to explain this subject, to insist on the short duration of the sun's rays, which cannot strike the different sides of mountains but for a few hours, and even this not always. A horizontal plain, when the sun is clear, is exposed at mid-day to the perpendicular and undiminished action of these rays, while they fall but obliquely on a plain not much inclined, or on the sides of a high pile of steep rocks. But let us conceive for a moment an insulated point, half the height of the atmosphere, at a distance from all mountains, as well as from the clouds which float in the air. The more a medium is transparent, the less heat it ought to receive by the immediate action of the sun. The free passage which a very transparent body allows to the rays of light, shows that its small particles are hardly touched by them. Indeed what impression could they make on it when they pass through almost without obstruction? Light, when it consists of parallel rays, does not by passing through a foot of free atmospheric air, near the earth, lose an hundred thousandth part of its force. From this we may judge how few rays are weakened, or can act on this fluid, in their passage through a stratum of the diameter not of an inch or a line, but of a particle. Yet the subtilty and transparency are still greater at great heights, as was obvious on the Cordilleras, when we looked at distant objects. Lastly, the grosser air is heated below by the contact or neighbourhood of bodies of greater density than itself, which it surrounds, and on which it rests; and the heat may be communicated by little and little to a certain distance. The inferior parts of the atmosphere by this means contract daily a very considerable degree of heat, and may receive it in proportion to its density or bulk. But it is evident, that the same thing cannot happen at the distance of a league and an half or two leagues above the surface of the earth, although the light there may be something more active. The air and the wind therefore must at this height be extremely cold, and colder in proportion to the elevation.

"Besides, the heat necessary to life is not merely that which we receive every instant from the sun. The momentary degree of this heat corresponds to a very small part of that which all the bodies around us have imbibed, and by which ours is chiefly regulated. The action of the sun only serves to maintain nearly in the same state the sum of the total heat, by repairing thro' the day the loss it sustains through the night, and at all times. If the addition be greater than the loss, the total heat will increase, as it happens in summer, and it will continue to accumulate in a certain degree; but for the reasons already given, this accumulation cannot be very great on the top of a mountain, where the summit which rises high, is never of great bulk. The lowest state of the thermometer in every place is always in proportion to the heat acquired by the soil; and that heat being very small on the top of a mountain, the quantity added to it by the sun during the day must be comparatively greater; and the accumulated heat will be more in a condition to receive increase in proportion to its distance from the degree which it cannot pass.

"Another particular observable on all the high places of the Cordilleras, and which depends on the same cause, is, that when we leave the shade, and expose ourselves to the sunshine, we feel a much greater difference than we do here in our fine days when the weather is temperate. Every thing contributes at Quito to make the sun exceedingly powerful: a single step from an exposed place to the shade gives the sensation of cold: this would not be the case if the quantity of heat acquired by the soil were more considerable. We now also see why the same thermometer, put first into the shade and then in the sun, does not undergo the same changes at all times and in all places. In the morning, upon Pinchincha, this instrument is generally a few degrees below the freezing point, which may be reckoned the natural temperature of the place; but when during the day we expose it to the sun, it is easy to imagine that the effect must be great, and much more than double in whatever way it is measured."

19 Burning glasses equally powerful on the tops of mountains as on plains.

This theory is adopted by M. Saussure, who adds the following fact to prove that the action of the sun's rays, considered abstractedly, and independent of any extrinsic source of cold, is as great on mountains as on plains; viz. that the power of burning lenses and mirrors is the same at all heights. To ascertain this fact, our author procured a burning-glass so weak that at Geneva it would just set fire to tinder. This he carried with some of the same tinder, to the top of the mountain Saleve (a height of 3000 feet); where it not only produced the same effect, but apparently with greater facility than on the plain. Being persuaded then, that the principal source of cold on the tops of high mountains is their being perpetually surrounded with an atmosphere which cannot be much heated either by the rays of the sun on account of its transparency, or by the reflection of them from the earth by reason of its distance, he wished to know, whether the direct solar rays on the top of a high mountain had the same power as on the plain, while the body on which they acted was placed in such a manner as to be unaffected by the surrounding air. For this purpose he instituted a set of experiments, from which he drew the following conclusions, viz. that a difference of 777 toises in height, diminishes the heat which the rays of the sun are able to communicate to a body exposed to the external air, 14° of the thermometer; that it diminishes the heat of a body partially exposed, only 6°; and that it augments by 1° the heat of a third body completely defended from the air.

20 Atmosphere every where counteracts the heat of the sun.

Hence it appears that the atmosphere, though so essentially necessary to the support of fire, is some how or other the greatest antagonist of heat, and most effectually counteracts the operation of the solar rays in producing it. This power it seems to exert at all distances, at the surface as well as in the higher regions. From some experiments made by M. Pictet, it appears, that

21 Is colder very near the surface of the ground than at some distance.

that even in places exposed to the rays of the sun, the heat, at five feet distance from the ground, is greater only by one or two degrees than at 50 feet above the surface, though the ground was at that time 15 or 20° warmer than the air immediately in contact with it. Inconsiderable as this difference is, however, it does not hold as we go higher up: for if it did, the cold on the top of the mountain of Saleve, which is 3000 feet above the level of the lake of Geneva, would be 60° greater than at the foot it; whereas in reality it is only 10°. In the night time the case is reversed; for the stratum of air, at five feet from the ground, was found by Mr Pictet to be colder than that at 50. Besides this, different strata of the atmosphere are found to possess very different and variable degrees of cold, without any regard to their situation high up or low down. In the year 1780, Dr Wilson of Glasgow found a very remarkable cold existing close to the surface of the ground; so that the thermometer, when laid on the surface of the snow, sunk many degrees lower than one suspended 24 feet above it. It has been likewise observed, that in clear weather, though the surface of the earth be then most liable to be heated by the sun, yet after that is set, and during the night, the air is coldest near the ground, and particularly in the valleys. Experiments on this subject were made for a whole year by Mr James Sex, who has given an account of them in the 78th volume of the Philosophical Transactions. He suspended thermometers (constructed in such a manner as to show the true maximum and minimum of heat that might take place in the observer's absence) in a shady northern aspect, and at different heights in the open air. One of these was placed at the height of 9 feet, and the other at that of 220 from the ground; and the observations were continued, with only a few days omission, from July 1784 to July 1785. The greatest variations of heat were in the months of October and June; in the former the thermometers generally differed most in the night, and in the latter mostly in the day. From the 25th to the 28th of October, the heat below, in the night time, exceeded in a small degree the heat above; at which time there was frequent rain mingled with hail. From the 11th to the 14th, and also on the 31st, there was no variation at all; during which time likewise the weather was rainy: all the rest of the month proving clear, the air below was found colder than that above, sometimes by nine or ten degrees. In the month of June, the greatest variations took place from the 11th to the 15th, and from the 25th to the 30th; and at both these times there appeared to be two currents of wind, the upper from the south-west and the lower from the north-east. Sometimes these were rendered visible by clouds, in different strata, moving in different directions, and sometimes by clouds moving in a contrary direction to a very sensible current of air below. On cloudy nights the lowest thermometer sometimes showed the heat to be a degree or two greater than the upper one; but in the day time the heat below constantly exceeded that above more than in the month of October.

22 Mr Sex's experiments on this subject.

To determine whether the nocturnal refrigeration was augmented by a nearer approach to the earth, two thermometers were placed in the midst of an open meadow, on the bank of the river near Canterbury. One was placed on the ground, and the other only six feet above it. The thermometer, at six feet distance from the ground, agreed nearly with the former at nine feet; but the nocturnal variations were found to correspond entirely with the clearness or the cloudiness of the sky: and though they did not always happen in proportion to their respective altitudes, yet when the thermometers differed in any respect, that on the ground always indicated the greatest degree of cold.

The difference betwixt these two thermometers, at the small distance of six feet from each other, being found no less than three degrees and an half, the number of thermometers in the meadow was augmented to four. One was sunk in the ground, another placed just upon it, and the third suspended at three feet above it. Three others were placed on a rising ground where the land was level with the cathedral tower, and about a mile distant from it. One of these was likewise sunk in the ground, another placed just upon it, and a third suspended six feet above it. With these seven thermometers, and the two first mentioned, which were placed in the city, he continued his observations for 20 days; but as the weather happened to be cloudy during the whole of that space, excepting for seven or eight days, no considerable variation happened excepting on these days. The result of the experiments was, that the cold was generally greater in the valley than on the hill; but the variations between the thermometers on the ground and those six feet above them, were often as great on the hill as in the valley.

Thus it was perceived that a difference of temperature took place at the distance of only three feet from the ground; but the length of the thermometers hitherto made use of rendered it impossible to make any experiment at a smaller distance. Two new ones, therefore, were formed by bending down the large tube, the body or bulb of the thermometer, to an horizontal position, while the stem remained in a vertical one; by which method the temperature might be observed to the distance of a single inch. Sometimes, in clear weather, these two horizontal thermometers were placed in the open air, one within an inch of the ground, and the other nine inches above it. When the variation among the other thermometers was considerable, a difference was likewise perceived between these; the lower one sometimes indicating more than two degrees less heat than the upper one, though placed so near each other.

From these experiments Mr Sex concludes, that a greater diminution of heat frequently takes place near the earth in the night-time than at any altitude in the atmosphere within the limits of his inquiry, that is, 220 feet from the ground; and at such times the greatest degrees of cold are always met with nearest the surface of the earth. 23 His conclusions from these experiments.

This is a constant and regular operation of nature, under certain circumstances and dispositions of the atmosphere, and takes place at all seasons of the year; and this difference never happens in any considerable degree but when the air is still, and the sky perfectly unclouded. The moistest vapour, as dews and fogs, did not at all impede, but rather promote, the refrigeration. In very severe frosts, when the air frequently deposites a quantity of frozen vapour, it is commonly found

Atmosphere.

found greatest; but the excess of heat which in the day-time was found at the lower station in summer, diminished in winter almost to nothing.

24 Mr Darwin's experiments on cold produced by the rarefaction of air.

It has been observed, that a thermometer, included in a receiver, always sinks when the air begins to be rarefied. This has been thought to arise, not from any degree of cold thus produced, but from the sudden expansion of the bulb of the thermometer in consequence of the removal of the atmospherical pressure: But from some late experiments related, Phil. Transf. vol. 78. by Mr Darwin, it appears that the atmosphere always becomes warm by compression, and cold by dilatation from a compressed state. These experiments were,

1. The blast from an air-gun was repeatedly thrown upon the bulb of a thermometer, and it uniformly sunk it about two degrees. In making this experiment the thermometer was firmly fixed against a wall, and the air-gun, after being charged, was left for an hour in its vicinity, that it might previously lose the heat it had acquired in the act of charging: the air was then discharged in a continued stream on the bulb of the thermometer, with the effect already menioned.

2. A thermometer was fixed in a wooden tube, and so applied to the receiver of an air-gun, that, on discharging the air by means of a screw pressing on the valve of the receiver, a continued stream of air, at the very time of its expansion, passed over the bulb of the thermometer. This experiment was four times repeated, and the thermometer uniformly sunk from five to seven degrees. During the time of condensation there was a great difference in the heat, as perceived by the hand, at the two ends of the condensing syringe: that next the air-globe was almost painful to the touch; and the globe itself became hotter than could have been expected from its contact with the syringe. "Add to this (says Mr Darwin), that in exploding an air-gun the stream of air always becomes visible, which is owing to the cold then produced precipitating the vapour it contained; and if this stream of air had been previously more condensed, or in greater quantity, so as not instantly to acquire heat from the common atmosphere in its vicinity, it would probably have fallen in snow."

3. A thermometer was placed in the receiver of an air-pump, and the air being hastily exhausted, it sunk two or three degrees; but after some minutes regained its former station. The experiment was repeated with a thermometer open at the top, so that the bulb could not be affected by any diminution of the external pressure; but the result was the same. Both during exhaustion and readmission of the air into the receiver, a steam was regularly observed to be condensed on the sides of the glass; which, in both cases, was in a few minutes reabsorbed, and which appeared to be precipitated by being deprived of its heat by the expanded air.

4. A hole, about the size of a crow-quill, was bored into a large air-vessel placed at the commencement of the principal pipe of the water-works of Derby. There are four pumps worked by a water-wheel, the water of which is first thrown into the lower part of this air-vessel, and rises from thence to a reservoir about 35 or 40 feet above the level; so that the water in this vessel is constantly in a state of compression. Two thermometers were previously suspended on the leaden air-vessel, that they might assume the temperature of it, and as soon as the hole above mentioned was opened, had their bulbs applied to the stream of air which issued out; the consequence of which was, that the mercury sunk four degrees in each. This sinking of the mercury could not be ascribed to any evaporation of moisture from their surfaces, as it was seen both in exhausting and admitting the air into the exhausted receiver mentioned in the last experiment, that the vapour which it previously contained was deposited during its expansion.

5. There is a curious phenomenon observed in the fountain of Hiero, constructed on a very large scale, in the Chemnicensian mines in Hungary. In this machine the air, in a large vessel, is compressed by a column of water 260 feet high; a stop-cock is then opened; and as the air issues with great vehemence, and in consequence of its previous condensation becomes immediately much expanded, the moisture it contains is not only precipitated, as in the exhausted receiver abovementioned, but falls down in a shower of snow, with isicles adhering to the nose of the cock. See Phil. Transf. vol. 52.

25 His conclusions with regard to cold on the tops of mountains.

From this phenomenon, as well as the four experiments above related, Mr Darwin thinks "there is good reason to conclude, that in all circumstances where air is mechanically expanded, it becomes capable of attracting the fluid matter of heat from other bodies in contact with it.

"Now, (continues he) as the vast region of air which surrounds our globe is perpetually moving along its surface, climbing up the sides of mountains, and descending into the valleys; as it passes along, it must be perpetually varying the degree of heat according to the elevation of the country it traverses: for, in rising to the summits of mountains, it becomes expanded, having so much of the pressure of the superincumbent atmosphere taken away; and when thus expanded, it attracts or absorbs heat from the mountains in contiguity with it; and, when it descends into the valleys, and is compressed into less compass, it again gives out the heat it has acquired to the bodies it comes in contact with. The same thing must happen to the higher regions of the atmosphere, which are regions of perpetual frost, as has lately been discovered by the aerial navigators. When large districts of air, from the lower parts of the atmosphere, are raised two or three miles high, they become so much expanded by the great diminution of the pressure over them, and thence become so cold, that hail or snow is produced by the precipitation of the vapour: and as there is, in these high regions of the atmosphere, nothing else for the expanded air to acquire heat from after it has parted with its vapour, the same degree of cold continues, till the air, on descending to the earth, acquires its former state of condensation and of warmth.

"The Andes, almost under the line, rests its base on burning sands; about its middle height is a most pleasant and temperate climate covering an extensive plain, on which is built the city of Quito; while its forehead is encircled with eternal snow, perhaps coeval with the mountain. Yet, according to the accounts of Don Ulloa, these three discordant climates seldom encroach

croach much on each other's territories. The hot winds below, if they afcend, become cooled by their expanfion; and hence they cannot affect the fnow upon the fummit; and the cold winds that fweep the fummit, become condenfed as they defcend, and of temperate warmth before they reach the fertile plains of Quito."

26 Difficulties ftill remain on the fubject.

Notwithftanding all thefe explanations, however, feveral very confiderable difficulties remain with regard to the heat and cold of the atmofphere. That warm air fhould always afcend; and thus, when the fource of heat is taken away by the abfence of the fun, that the ftratum of atmofphere lying immediately next to the earth fhould be fomewhat colder than that which lies a little farther up; is not at all to be wondered at. We have an example fomewhat fimilar to this in the potter's kiln; where, after the veffels have been intenfely heated for fome time, and the fire is then withdrawn, the cooling always begins at bottom, and thofe that ftand lowermoft will often be quite black, while all the upper part of the furnace and the veffels next to to it, are of a bright red. It doth not, however, appear, why fuch degrees of cold fhould take place at the furface of the earth as we fometimes meet with. It is, befides, no uncommon thing to meet with large ftrata in the upper regions of the atmofphere, remarkable for their cold, while others are warmer than thofe at the furface; as we have been affured of by the teftimony of feveral aerial navigators. It is alfo difficult to fee why the air which has once afcended, and become rarefied to any extreme degree, fhould afterwards defcend among a denfer fluid of fuperior gravity, though indeed the atmofpherical currents by which this fluid is continually agitated may have confiderable effect in this way. See the article WINDS. See alfo HEAT, COLD, CONGELATION, CONDENSATION, &c.

For the quantity of water contained in the atmofphere, fee the articles HYGROMETER, CLOUDS, VAPOUR, &c. For the caufe of the elafticity of the atmofphere, fee ELASTICITY; and for an explanation of its various operations, fee METEOROLOGY. See alfo HAIL, RAIN, SNOW, &c.

The ufes of the atmofphere are fo many and fo various that it is impoffible to enumerate them. One of the moft effential is its power of giving life to vegetables, and fupporting that of all animated beings. For the latter purpofe however, it is not in all places equally proper: we fhall therefore conclude this article with fome remarks on

27 Of the falubrity of the atmofphere.

The Salubrity of the ATMOSPHERE.——The air on the tops of mountains is generally more falubrious than that in pits. Denfe air indeed is always more proper for refpiration than fuch as is more rare; yet the air on mountains, though much more rare, is more free from phlogiftic vapours than that of pits. Hence it has been found, that people can live very well on the tops of mountains, where the barometer finks to 15 or 16 inches. M. de Sauffure, in his journey upon the Alps, having obferved the air at the foot, on the middle, and on the fummits of various mountains, obferves, that the air of the very low plains feems to be the lefs falubrious; that the air of very high mountains is neither very pure, nor, upon the whole, feems fo fit for the lives of men, as that of a certain height above the level of the fea, which he eftimates to be about 200 or 300 toifes, that is, about 430 or 650 yards.

Dr White, in the lxviiith vol. of the Phil. Tranf. giving an account of his experiments on air made at York, fays, that the atmofpherical air was in a very bad ftate, and indeed in the worft he had ever obferved it, the 13th of September 1777; when the barometer ftood at 30.30, the thermometer at 69°; the weather being calm, clear, and the air dry and fultry, no rain having fallen for above a fortnight. A flight fhock of an earthquake was perceived that day.

The air of a bed-room at various times, viz. at night, and in the morning after fleeping in it, has been examined by various perfons; and it has been generally found, that after fleeping in it the air is lefs pure than at any other time. The air of privies, even in calm weather has not been found to be fo much phlogifticated as might have been expected, notwithftanding its difagreeable fmell.

From this and other obfervations, it is thought that the exhalations of human excrements are very little if at all injurious, except when they become putrid, or proceed from a difeafed body; in which cafe they infect the air very quickly.

28 Dr Ingenhoufz's experiments.

Dr Ingenhoufz, foon after he left London, fent an account of his experiments made in the year 1779 upon the purity of the air at fea and other parts; which account was read at the Royal Society the 24th of April 1780, and is inferted in the lxxth vol. of the Phil. Tranf. His firft obfervations were made on board a veffel in the mouth of the Thames, between Sheernefs and Margate, where he found that the air was purer than any other fort of common air he had met with before. He found that the fea-air taken farther from the land, viz. between the Englifh coaft and Oftend, was not fo pure as that tried before; yet this inferior purity feems not to take place always. The Doctor's general obfervations, deduced from his numerous experiments, are, "That the air at fea, and clofe to it, is in general purer, and fitter for animal life, than the air on the land, though it feems to be fubject to fome inconfiftency in its degree of purity with that of the land: That probably the air will be found in general much purer far from the land than near the fhore, the former being never fubject to be mixed with land air."

The Doctor in the fame paper tranfcribes a journal of experiments, fhowing the degree of purity of the atmofphere in various places, and under different circumftances; which we fhall infert here in an abridged manner.

29 His Journal of the purity of the air in different places.

The method ufed in thofe experiments, was to introduce one meafure of common air into the eudiometer-tube, and then one meafure of nitrous air. The moment that thefe two forts of elaftic fluids came into contact, he agitated the tube in the water-trough, and then meafured the diminution, expreffing it by hundredth parts of a meafure; thus, when he fays that fuch air was found to be 130, it fignifies, that after mixing one meafure of it with one of nitrous air, the whole mixed and diminifhed quantity was 130 hundredths of a meafure, viz. one meafure and 30 hundredths of a meafure more.

"The different degrees of falubrity of the atmofphere, ſphere, as I found it in general in my country-houſe at Southal-Green, ten miles from London, from June to September, lay between 103 and 109. I was ſurpriſed when, upon my return to town to my former lodgings in Pall-Mall Court, I found the common air purer in general in October than I uſed to find it in the middle of ſummer in the country; for on the 22d of October, at nine o'clock in the morning, the weather being fair and froſty, I found that one meaſure of common air, and one of nitrous air, occupied 100 ſubdiviſions in the glaſs-tube, or exactly one meaſure. That very day, at two o'clock in the afternoon (it being then rainy weather), the air was ſomewhat altered for the worſe. It gave 102. October the 23d, it being rainy weather, the air gave 102. October the 24th, the weather being ſerene, the air at nine o'clock in the morning gave 100. October the 25th, the ſky being cloudy at 11 o'clock in the morning, the air gave 102. At 11 o'clock at night, from five different trials, it gave 105. October the 26th, the weather being very dark and rainy, the air gave 105, as before."

The air at Oſtend was found by the Doctor to be generally very good, giving between 94 and 98. At Bruges, the air taken at ſeven o'clock at night gave 103. November the 8th, the air at Ghent at three in the afternoon gave 03.

November the 12th, the air of Bruſſels at ſeven o'clock P. M. gave $105\frac{1}{2}$. The next day the air of the lower part of the ſame city gave 106; that of the higheſt appeared to be purer, as it gave 104; which agrees with the common popular obſervation. November the 14th, both the air of the higheſt and that of the loweſt part of the city appeared to be of the ſame goodneſs, giving 103. The weather was froſty.

November the 22d, the air of Antwerp in the evening gave $109\frac{1}{2}$; the weather being rainy, damp, and cold. November the 23d, the air of Breda gave 106. The next day about 11 o'clock the air gave 102; the weather being fair, cold, and inclining to froſt. At ſeven o'clock it gave 103. Next day, being the 25th, the air gave 104; the weather being cold and rainy. The 26th it gave 103; the weather being very rainy, cold, and ſtormy. November the 27th, the air at the Moordyke cloſe to the water gave $101\frac{1}{2}$; the weather being fair and cold, but not froſty. This ſpot is reckoned very healthy. November the 28th, the air of Rotterdam gave 103; the weather being rainy and cold. November the 29th, the air of Delft gave 103; the weather being ſtormy and rainy.

November the 30th, the air of the Hague gave 104; the weather being cold, and the wind northerly. The firſt of December the weather underwent a ſudden change; the wind becoming ſoutherly and ſtormy, and the atmoſphere becoming very hot. The day after, Fahrenheit's thermometer ſtood at 54°; and the common air being repeatedly and accurately tried gave 116; and that preſerved in a glaſs phial from the preceding day gave 117; and that gathered cloſe to the ſea gave 115.

December the 4th, the air of Amſterdam gave 103; the weather being rainy, windy, and cold. The day after the weather continuing nearly the ſame, the air gave 102. December the 10th, the air of Rotterdam gave 101; the weather being rainy. December the 12th, being in the middle of the water between Dort and the Moordyke, the air gave 109; the weather being remarkably dark, rainy, and windy. December the 13th, the air of Breda in the morning gave 109; the weather continuing as the day before. And in the afternoon, the air gave $106\frac{1}{2}$; the weather having cleared up. December the 16th, the air of the lower part of the city of Antwerp gave 105, that of the higher part 104; the weather being rainy and temperate. December the 17th, the air of Antwerp gave 107; the weather continuing nearly as in the preceding day. December the 19th, the air of Bruſſels gave 109; the weather being rainy, windy, and rather warm. December the 21ſt, the air of Bruſſels gave 106; the weather being dry and cold. The next day the air and weather continued the ſame. December the 23d, the air of Mons gave 104; the weather being rainy and cold. December the 24th, the air near Bouchain gave $104\frac{1}{2}$; the weather being cloudy and cold. December the 25th, the air of Peronne gave $102\frac{1}{2}$; the weather being froſty. December the 26th, the air of Cuvilli gave 103; the weather froſty. December the 27th, the air of Senlis gave $102\frac{1}{2}$; the weather froſty. December the 29th, the air of Paris gave 103; the weather froſty. 1780, January the 8th, the air of Paris gave 100; the weather froſty. January the 13th, the air of Paris gave 98; hard froſt. 30

Thus far with Dr Ingenhouſz's obſervations. His apparatus was a very portable one, made by Mr Martin, which in reality is the eudiometer-tube and meaſure as uſed by Mr Fontana before he made his laſt improvement. "The whole of this apparatus (ſays Dr Ingenhouſz) was packed up in a box about ten inches long, five broad, and three and a half high. The glaſs-tube or great meaſure, which was 16 inches long, and divided in two ſeparate pieces, lay in a ſmall compaſs, and could be put together by braſs ſcrews adapted to the divided extremities. Inſtead of a water-trough, ſuch as is uſed commonly, I made uſe of a ſmall round wooden tube, &c." 31

Apparatus with which his experiments were made.

The Abbé Fontana, who has made a great number of very accurate experiments upon this ſubject, gives his opinion in the following words: "I have not the leaſt heſitation in aſſerting, that the experiments made to aſcertain the ſalubrity of the atmoſpherical air in various places in different countries and ſituations, mentioned by ſeveral authors, are not to be depended upon; becauſe the method they uſed was far from being exact (A), the elements or ingredients for the experiment were unknown and uncertain, and the reſults very different from one another.

Fontana's opinions on the ſubject.

"When all the errors are corrected, it will be found that the difference between the air of one country and that of another, at different times, is much leſs than what is commonly believed; and that the great differences found by various obſervers are owing to the fallacious effects of uncertain methods. This I advance from experience; for I was in the ſame error. I found very

(A) It is plain that Dr Ingenhouſz's method is not implied in this remark: ſince the Doctor's experiments were made long after, and the method uſed by him was properly that of Mr Fontana.

very great differences between the results of the experiments of this nature which ought to have been similar; which diversities I attributed to myself, rather than to the method I then used. At Paris I examined the air of different places at the same time, and especially of those situations where it was most probable to meet with infected air, because those places abounded with putrid substances and impure exhalations; but the differences I observed were very small, and much less than what could have been suspected, for they hardly arrived to one-fiftieth of the air in the tube. Having taken the air of the hill called *Mount Valerian*, at the height of about 500 feet above the level of Paris, and compared it with the air of Paris taken at the same time, and treated alike, I found the former to be hardly one-thirtieth better than the latter.

"In London I have observed almost the same. The air of Islington and that of London suffered an equal diminution by the mixture of nitrous air; yet the air of Islington is esteemed to be much better. I have examined the air of London taken at different heights (for instance, in the street, at the second floor, and at the top of the adjoining houses), and have found it to be of the same quality. Having taken the air at the iron gallery of St Paul's cupola, at the height of 313 feet above the ground, and likewise the air of the stone gallery, which is 202 feet below the other; and having compared these two quantities of air with that of the street adjoining, I found that there was scarce any sensible difference between them, although taken at such different heights.

"In this experiment a circumstance is to be considered, which must have contributed to render the abovementioned differences more sensible: this is, the agitation of the air of the cupola; for there was felt a pretty brisk wind upon it, which I observed to be stronger and stronger the higher I ascended; whereas in the street, and indeed in all the streets I passed through, there was no sensible wind to be felt. This experiment was made at four in the afternoon, the weather being clear. The quicksilver in the barometer at that time was 28,6 inches high, and Fahrenheit's thermometer stood at 54°."

A few lines after, Mr Fontana proceeds thus:— "From this we clearly see, how little the experiments hitherto published about the differences of common air are to be depended upon. In general, I find that the air changes from one time to another; so that the differences between them are far greater than those of the airs of different countries or different heights. For instance, I have found that the air of London in the months of September, October, and November, 1778, when treated with the nitrous air, gave II,I, 1,90, and II,II, 2,25, which is a mean result of many experiments which differed very little from each other. The 26th day of November last, I found the air for the first time much better, for it gave II,I 1,80, and II,II, 2,20; but the 14th of February 1779, the air gave II,I, 1,69, and II,II, 2,21; from whence it appears, that the air of this 14th of February was better than it had been six months before. There can be no doubt of the accuracy of the experiments, because I compared the air taken at different times with that which I had first used in the month of September, and which I had preserved in dry glass-bottles accurately stopped."

This difference in the purity of the air at different times, Mr Fontana farther remarks, is much greater than the difference between the air of the different places observed by him: notwithstanding this great change, as he observed, and as he was informed by various persons, no particular change of health in the generality of people, or facility of breathing, was perceived.

Mr Fontana lastly concludes with observing, that "Nature is not so partial as we commonly believe. She has not only given us an air almost equally good every where at every time, but has allowed us a certain latitude, or a power of living and being in health in qualities of air which differ to a certain degree. By this I do not mean to deny the existence of certain kinds of noxious air in some particular places; but only say, that in general the air is good every where, and that the small differences are not to be feared so much as some people would make us believe. Nor do I mean to speak here of those vapours and other bodies which are accidentally joined to the common air in particular places, but do not change its nature and intrinsical property. This state of the air cannot be known by the test of nitrous air; and those vapours are to be considered in the same manner as we should consider so many particles of arsenic swimming in the atmosphere. In this case it is the arsenic, and not the degenerated air, that would kill the animals who ventured to breathe it."

ATOCK, The capital of a province of the same name in the dominions of the Great Mogul. It is seated on a point of land where two large rivers meet, and is one of the best fortresses the Mogul has; but formerly nobody was permitted to enter it without a passport from the Mogul himself. E. Long. 72. 10. N. Lat. 32. 20.

ATOM, in philosophy, a particle of matter, so minute, as to admit of no division. Atoms are the *minima naturæ*, and are conceived as the first principles or component parts of all physical magnitude.

ATOMICAL PHILOSOPHY, or the doctrine of atoms, a system which, from the hypothesis that atoms are endued with gravity and motion, accounted for the origin and formation of things. This philosophy was first broached by Moschus, some time before the Trojan war; but was much cultivated and improved by Epicurus; whence it is denominated the *Epicurean philosophy*. See EPICUREAN.

ATONEMENT. See EXPIATION.

ATONY, in medicine, a defect of tone or tension, or a laxity or debility of the solids of the body.

ATOOI, one of the Sandwich islands, situated in E. Long. 200. 20. N. Lat. 21. 57. Towards the north-east and north-west, the face of the country is ragged and broken; but to the southward it is more even. The hills rise from the sea-side with a gentle acclivity, and at a little distance back are covered with wood. Its produce is the same with that of the other islands of this cluster; but its inhabitants greatly excel the people of all the neighbouring islands in the management of their plantations. In the low grounds, contiguous to the bay wherein our navigators anchored, ed, these plantations were regularly divided by deep ditches; the fences were formed with a neatness approaching to elegance, and the roads through them were finished in such a manner as would have reflected credit even on an European engineer.

The island is about 300 miles in circumference. The road, or anchoring-place, which our vessels occupied, is on the south-west side of the island, about two leagues from the west end, before a village named Wymoa. As far as was sounded, the bank was free from rocks; except to the eastward of the village, where there projects a shoal on which are some rocks and breakers. This road is somewhat exposed to the trade-wind; notwithstanding which defect, it is far from being a bad station, and greatly superior to those which necessity continually obliges ships to use, in countries where the winds are not only more variable but more boisterous; as at Madeira, Teneriffe, the Azores, &c. The landing too is not so difficult as at most of those places; and, unless in very bad weather, is always practicable. The water in the neighbourhood is excellent, and may be conveyed with ease to the boats. But no wood can be cut at any convenient distance, unless the islanders could be prevailed upon to part with the few etooa trees (*cordia sebestina*) that grow about their villages, or a species called *dooe dooe*, which grows farther up the country. The ground, from the wooden part to the sea, is covered with an excellent kind of grass, about two feet in height, which sometimes grows in tufts, and appeared capable of being converted into abundant crops of fine hay. But on this extensive space not even a shrub grows naturally.

Besides taro, the sweet potatoe, and other similar vegetables used by our crews as refreshments, among which were at least five or six varieties of plantains, the island produces bread-fruit; which, however, seems to be scarce. There are also a few cocoa palms; some yams; the kappe of the Friendly islands, or Virginian arum; the etooa tree, and odoriferous gardenia or cape jasmine. Our people also met with several trees of the dooe dooe, that bear the oily nuts, which are stuck upon a kind of skewer and made use of as candles. There is a species of sida, or Indian mallow; also the morinda citrifolia, which is here called *none*; a species of convolvulus; the ava or intoxicating pepper, besides great quantities of gourds. These last grow to a very large size, and are of a remarkable variety of shapes, which are perhaps the effect of art.

The scarlet birds, which were brought for sale, were never met with alive; but one small one was seen, about the size of a canary bird, of a deep crimson colour; also a large owl, two brown hawks or kites, and a wild duck. Other birds were mentioned by the natives; among which were the otoo, or blueish heron, and the torata, a sort of of whimbrel. It is probable that the species of birds are numerous, if we may judge by the quantity of fine yellow, green, and small, velvet-like, blackish feathers used upon the cloaks and other ornaments worn by these people. Fish, and other productions of the sea, were to appearance not various. The only tame or domestic animals found here were hogs, dogs, and fowls, which were all of the same kind that had been met with at the islands of the South Pacific. There were also small lizards, and some rats.

The inhabitants of Atooi are of the middle size, and in general stoutly made. They are neither remarkable for a beautiful shape nor for striking features. Their visage, particularly that of the women, is sometimes round, but others have it long; nor can it justly be said, that they are distinguished as a nation by any general cast of countenance. Their complexion is nearly of a nut brown; but some individuals are of a darker hue. They are far from being ugly, and have, to all appearance, few natural deformities of any kind. Their skin is not very soft nor shining; but their eyes and teeth are, for the most part, pretty good. Their hair in general is straight; and though its natural colour is usually black, they stain it, as at the Friendly and other islands. They are active, vigorous, and most expert swimmers; leaving their canoes upon the most frivolous occasion, diving under them, and swimming to others, though at a considerable distance. Women with infants at the breast, when the surf was so high as to prevent their landing in the canoes, frequently leapt overboard, and swam to the shore, without endangering their little ones. They appeared to be of a frank, chearful disposition; and are equally free from the fickle levity which characterizes the inhabitants of Otaheite, and the sedate cast which is observable among many of those of Tongataboo. They seem to cultivate a sociable intercourse with each other; and, except the propensity of thieving, which is as it were innate in most of the people in those seas, they appeared extremely friendly. It was pleasing to observe with what affection the women managed their infants, and with what alacrity the men contributed their assistance in such a tender office; thus distinguishing themselves from those savages who consider a wife and a child as things rather necessary than desirable or worthy of their regard and esteem. From the numbers that were seen assembled at every village in coasting along, it was conjectured that the inhabitants of this island are pretty numerous. Including the straggling houses, it was computed there might perhaps be, in the whole island, sixty such villages as that near which our ships anchored; and allowing five persons to each house, there would be in every village five hundred, or thirty thousand upon the island. This number is by no means exaggerated; for there were sometimes three thousand people at least collected upon the beach, when it could not be supposed that above a tenth part of the natives were present.

ATRA BILIS, BLACK BILE, or MELANCHOLY. According to the ancients it hath a twofold origin: 1st, From the grosser parts of the blood, and this they called the *melancholy humour*. 2d, From yellow bile being highly concocted. Dr Percival, in his Essays Med. and Exp. suggests, that it is the gall rendered acrid by a stagnation in the gall-bladder, and rendered viscid by the absorption of its fluid parts. Bile in this state discharged into the duodenum, occasions universal disturbance and disorder until it is evacuated; it occasions violent vomiting, or purging, or both; and previous to this the pulse is quick, the head aches, a delirium comes on, a hiccough, intense thirst, inward heat, and a fetid breath. Some describe this kind of bile as being acid, harsh, corroding, and, when poured on the ground, bubbling up, and raising the earth after the manner of a ferment. Dr Percival says, that by the

the use of the *infus. senæ limoniet.* warmed with the *tinct. columb.* he had checked the vomitings occasioned by this matter.

Atra dies, in antiquity, denotes a *fatal day* whereon the Romans received some memorable defeat. The word literally imports *a black day;* a denomination taken from the colour, which is the emblem of death and mourning. Whence the Thracians had a custom of marking all their happy days with white stones or calculi, and their unhappy days with black ones: which they cast, at the close of each day, into an urn. At the person's death the stones were taken out; and from a comparison of the numbers of each complection, a judgment was made of the felicity or infelicity of his course of life. The *dies atræ* or *artri,* were afterwards denominated *nefasti,* and *posteri.* Such in particular was the day when the tribunes were defeated by the Gauls, at the river Allia, and lost the city; also that whereon the battle of Cannæ was fought; and several others marked in the Roman calendar as *atræ* or unfortunate.

ATRACTYLIS, distaff thistle: A genus of the polygamia æqualis order, belonging to the syngenesia class of plants; and in the natural method ranking under the 49th order, *Compositæ-capitatæ.* The corolla is radiated; and each of the little corollæ of the radius has five teeth.

Species. 1. The cancellata, or small cnicus, is an annual plant rising about eight or nine inches high, with a slender stem, garnished with hoary leaves, having spines on their edges. At the top of these branches are sent out two or three slender stalks, each terminated by a head of flowers like those of the thistle. The empalement is curiously netted over, and is narrow at the top, but swelling below; and contains many florets of a purplish colour. These are each succeeded by a single downy seed, which in cold years do not ripen in Britain. 2. The humilis, or purple prickly cnicus, rises about a foot high, with indented leaves, having small spines on their edges. The upper part of the stalk is divided into two or three slender branches, each supporting a head of purple flowers, having rays inclosed in a scaly empalement. The flowers appear in June; but unless the season is warm, the seeds will not ripen in Britain. 3. The gummifera, or prickly gum-bearing cnicus, known among physicians by the name of *carline thistle.* This sends out many narrow leaves, which are deeply serrated, and armed with spines on their edges. These lie close on the ground; and between them the flower is situated, without a stalk, and having many florets inclosed in a prickly empalement. Those on the border are white; but such as compose the disk are of a yellowish colour. It flowers in July, but never perfects seeds in Britain.

Culture. All these plants are natives of the warm parts of Europe, as Spain, Sicily, and the Archipelago islands, from whence their seeds must be procured. They must be sown upon an open bed of light earth, where the plants are to remain; and when the plants come up, they should be thinned, so as to leave them three or four inches asunder. The roots of the second will last two or three years, and the third is a perennial plant.

Medicinal Uses. The root of the third sort was formerly used as a warm diaphoretic and alexipharmic; but it never came much into use in Britain, and the present practice has entirely rejected it. The root is about an inch thick, externally of a pale rusty brown colour, corroded as it were in the surface; and perforated with numerous small holes, so as to appear worm-eaten when cut. It has a strong smell; and a subacid, bitterish, and weakly aromatic taste. Frederic Hoffman the elder relates, that he has observed a decoction of it in broth to occasion vomiting.

ATRÆTI, in medicine, infants having no perforation in the anus, or persons imperforated in the vagina or urethra.

ATRAGENE, in botany; A genus of the polyandria order belonging to the polygamia class of plants. The calyx has four leaves; the petals are 12; and the seeds are candated. There are three species, all natives of the east.

ATRAPHAXIS: A genus of the dygnia order, belonging to the hexandria class of plants; and in the natural method ranking under the 12th order, *Holoraceæ.* The calyx has two leaves; the petals are two, and sinuated; and there is but one seed. There are two species, both natives of warm countries, but meriting no particular description.

ATREBATII, a people of Britain, seated next to the Bibroci, in part of Berkshire and part of Oxfordshire. This was one of those Belgic colonies which had come out of Gaul into Britain, and there retained their ancient name. For the Atrebatii were a tribe of the Belgæ, who inhabited that country which is now called Artois. They are mentioned by Cæsar among the nations which composed the Belgic confederacy against him; and the quota of troops which they engaged to furnish on that occasion was 15,000. Comius of Arras was a king or chieftain among the Atrebatii in Gaul in Cæsar's time: and he seems to have possessed some authority, or at least some influence, over our Atrebatii in Britain; for he was sent by Cæsar to persuade them to submission. This circumstance makes it probable that this colony of the Atrebatii had not been settled in Britain very long before that time. The Atrebatii were among those British tribes which submitted to Cæsar; nor do we hear of any remarkable resistance they made against the Romans at their next invasion under Claudius. It is indeed probable, that before the time of this second invasion they had been subdued by some of the neighbouring states, perhaps by the powerful nation of the Cattivellauni, which may be the reason they are so little mentioned in history. Calliva Attrebatum, mentioned in the seventh, twelfth, thirteenth, and fourteenth itinera of Antoninus, and called by Ptolemy *Calcua,* seems to have been the capital of the Atrebatii; though our antiquaries differ in their sentiments about the situation of this ancient city, some of them placing it at Wallingford, and others at Ilchester.

ATREUS, in fabulous history, the son of Pelops and Hippodamia, and the father of Agamemnon and Menelaus, is supposed to have been king of Mycenæ and Argos about 1228 years before the Christian æra. He drove his brother Thyestes from court, for having a criminal commerce with Ærope his wife; but understanding that he had had two children by her, he sent for him again, and made him eat them; at which

which horrid action the sun, it is said, withdrew his light.

ATRI, a town of Italy, in the farther Abruzzo in the kingdom of Naples, with the title of a duchy; it is the see of a bishop, and is seated on a craggy mountain, four miles from the Adriatic Sea. E. Long. 13.8. N. Lat 42. 45.

ATRIENSES, in antiquity, a kind of servants or officers in the great families at Rome, who had the care and inspection of the atria and the things lodged therein.

These are otherwise called atriarii, though some make a distinction between *atrienses* and *atriarii*; suggesting that the latter were an inferior order of servants, perhaps assistants of the atrienses, and employed in the more servile offices of the atrium, as to attend at the door, sweep the area, &c.

The artienses are represented as servants of authority and command over the rest: they acted as procurators, or agents, of their master, in selling his goods, &c. To their care were committed the statues and images of the master's ancestors, &c. which were placed round the atrium; and which they carried in procession at funerals, &c.

In the villas, or country-houses, the atrienses had the care of the other furniture and utensils, particularly those of metal, which they were to keep bright from rust. Other things they were to hang from time to time in the sun, to keep them dry, &c. They were cloathed in a short white linen habit, to distinguish them, and prevent their loitering from home.

ATRIP, in nautical language, is applied either to the anchor or sails. The anchor is atrip, when it is drawn out of the ground in a perpendicular direction, either by the cable or buoy-rope. The top-sails are atrip, when they are hoisted up to the mast-head, or to their utmost extent.

ATRIPLEX, ORACH, or ARACH: A genus of the monœcia order, belonging to the polygamia class of plants; and, in the natural method, ranking under the 12th order, *Holoraceæ*. The calyx of the hermaphrodite flower has five leaves: there is no corolla; the stamina are five, and the stylus is bifid; the seed is one, and depressed.

Species. 1. The hortensis, or garden orach, was formerly cultivated in gardens, and used as a substitute for spinage, to which it is still preferred by some, tho' in general it is disliked by the English; however, it still maintains its credit in France, as also in the northern parts of England. There are three or four varieties of this plant, whose only difference is their colour; one is a deep green, another a dark purple, and a third with green leaves and purple borders. 2. The halimus, or broad-leaved orach, was formerly cultivated in gardens as a shrub, by some formed into hedges, and constantly sheared to keep them thick: but this is a purpose to which it is by no means adapted, as the shoots grow so vigorous, that it is impossible to keep the hedge in any tolerable order; and, what is worse, in severe winters the plants are often destroyed. 3. The petulacoides, or shrubby sea-orach, grows wild by the sea-side in many places of Britain. It is a low undershrub, seldom rising above two feet and an half, or at most three feet high; but becomes very bushy. This may have a place in gardens among other low shrubs, where it will make a pretty diversity. Besides these, nine other species are enumerated by botanical writers, but the abovementioned are the most remarkable.

Culture, &c. The first sort is annual, so must be propagated by seeds. These are to be sown at Michaelmas, soon after the seeds are ripe. The plants require no other culture than to be kept free from weeds, to hoe them when they are about an inch high, and to cut them down when they are too thick, so as to leave them about four inches asunder. When these plants are sown in a rich soil, and allowed a good distance from each other, the leaves will grow very large, and in this their goodness consists. This must be eaten whilst it is young; for when old, the leaves become tough, and are good for nothing. This species is an article of the materia medica; a decoction of the leaves is recommended in costiveness, where the patient is of a hot bilious disposition.—The second sort may be propagated by cuttings. These are to be planted in any of the summer months, in a shady border; where they will soon take root, and be fit against the following Michaelmas to transplant into those places where they are to remain.—The third sort requires very little culture. It may be also propagated from cuttings, and is to be planted in a poor gravelly soil.

ATRIUM, in ecclesiastical antiquity, denotes an open place or court before a church, making part of what was called the *narthex* or *antetemple*.

The atrium in the ancient churches was a large area or square plat of ground, surrounded with a portico or cloyster, situate between the porch or vestible of the church, and the body of the church.

Some have mistakenly confounded the atrium with the porch or vestible, from which it was distinct; others with the narthex, of which it was only a part.

The atrium was the mansion of those who were not suffered to enter farther into the church. More particularly, it was the place where the first class of penitents stood to beg the prayers of the faithful as they went into the church.

ATRIUM is also used, in the cannon law, for the cemetry or church-yard. In this sense we find a law prohibiting buildings to be raised in *atrio ecclesiæ*, except for the clergy; which the glossary explains thus, *id est in cæmeterio*, which includes the space of forty paces around a large church, or thirty round a little church or chapel.

ATROPA, DEADLY NIGHT-SHADE: A genus of the monogynia order, belonging to the pentandria class of plants; and in the natural method ranking under the 25th order, *Luridæ*. The corolla is campanulated; the stamina are distant; the berry is globular, and consists of two cells. The species are five; of which the three following are the most remarkable: 1. The belladonna grows wild in many parts of Britain. It hath a perennial root, which sends out strong herbaceous stalks of a purplish colour, which rise to the height of four or five feet, garnished with entire oblong leaves, which towards autumn change to a purplish colour. The flowers are large, and come out singly between the leaves, upon long foot-stalks; bell-shaped, and of a dusky colour on the out-side, but purplish within. After the flower is past, the germen turns to a large round berry a little flatted at the top. It is first green; but when ripe, turns to a shining black,

black, sits close upon the empalement, and contains a purple juice of a nauseous sweet taste, and full of small kidney-shaped seeds. 2. The frutescens is a native of Spain, and rises with a shrubby stem to the height of six or eight feet; dividing into many branches garnished with round leaves, in shape like those of the storax tree: these are placed alternately on the branches. The flowers come out between the leaves on short foot-stalks, shaped like those of the former, but much less; of a dirty yellowish colour, with a few brown stripes: but these are never succeeded by berries in Britain. 3. The herbacea, with an herbaceous stalk, is a native of Campeachy. This hath a perennial root, which puts forth several channelled herbaceous stalks rising about two feet; and towards the top they divide into two or three small branches garnished with oval leaves four inches long and three broad, having several prominent transverse ribs on the under side. The flowers come out from between the leaves on short foot-stalks; they are white, and shaped like those of the common sort, but smaller. It flowers in July and August, but seldom ripens its fruit in Britain. 4. The mandragora, or mandrake, which has been distinguished into the male and female. The male mandrake has a very large, long, and thick root; it is largest at the top or head, and from thence gradually grows smaller. Sometimes it is single and undivided to the bottom; but more frequently it is divided into two or more parts. When only parted into two, it is pretended that it resembles the body and thighs of a man. From this root there arise a number of very long leaves, broadest in the middle, narrow towards the base, and obtusely pointed at the end; they are of a foot or more in length, and five inches or thereabouts in breadth; they are of a dusky and disagreeable green colour, and of a very fœtid smell. The female mandrake perfectly resembles the other in its manner of growth; but the leaves are longer and narrower, and of a darker colour, as are also the seeds and roots. It grows naturally in Spain, Portugal, Italy, and the Levant.

Culture. The first species, which is remarkable for its poisonous qualities, is very seldom admitted in gardens, nor should it ever be cultivated or allowed to grow in those places to which children have access. The other kinds are propagated by seeds, and placed in a stove, as is requisite for the more tender plants.

Qualities, &c. The first species, as we have already observed, is a strong poison. Mr Ray gives a good account of the symptoms that follow the taking of it inwardly, by what happened to a mendicant friar upon his drinking a glass of mallow wine in which the herb was infused. In a short time he became delirious, and soon after was seized with a grining laughter; then with several irregular motions, and at last with a real madness, and such a stupidity as those have who are sottishly drunk: but after all he was cured by a draught of vinegar. Buchannan also gives an account of the destruction of the army of Sweno the Dane, when he invaded Scotland, by mixing a quantity of the belladonna berries with the drink which the Scots were, according to a treaty of truce, to supply them with. This so intoxicated the Danes, that the Scots fell upon them in their sleep, and killed the greatest part of them, so that there were scarcely men enough left to carry off their king. There have also been many instances in Britain of children being killed by eating berries of a fine black colour, and about the size of a small cherry, which are no other than those of belladonna. When an accident of this kind is discovered in time, a glass of warm vinegar will prevent the bad effects.

The third species has been recommended in cases of barrenness, but without foundation. Its fresh root is a violent purge, the dose being from ten grains to twenty in substance, and from half a dram to a dram in infusion. It has been found to do service in hysteric complaints; but must be used with great caution, otherwise it will bring on convulsions, and many other mischievous symptoms. It has also a narcotic quality. At present only the fresh leaves are sometimes used in anodyne and emollient cataplasms and fomentations. It used to be an ingredient in one of the old officinal unguents; but both that and the plant itself are now rejected from our pharmacopœias. It still however retains a place in the foreign ones, and may perhaps be considered as deserving farther attention.

Naturalists tell strange stories of this plant: but setting aside its soporiferous virtue, the modern botanists will scarce warrant any of them, nor even that human figure ordinarily ascribed to its roots, especially since the discovery of the artifice of the Charletans in fashioning it, to surprise the credulity of the people. The figure given in Plate XCI. however, was taken from a genuine root.

Moses informs us, (Gen. xxx. 14.) that Reuben, the son of Leah, being in the field, happened to find mandrakes, which he brought home to his mother. Rachel had a mind to them, and obtained them from Leah, upon condition that she should consent that Jacob should be Leah's bedfellow the night following. The term דודאים *dudaim,* here made use of by Moses, is one of those words of which the Jews at this day do not understand the true signification. Some translate it *violets,* others *lillies,* or *jessamine.* Junius calls it *agreeable flowers;* Codurquus makes it *truffle,* or *mushroom;* and Calmet will have it to be the *citron.* Those that would support the translation of *mandrakes* plead, that Rachel being barren, and having a great desire to conceive, coveted Leah's mandrakes, it may be presumed, with a view to its prolific virtues. The ancients have given to mandrakes the name of the *apples of love,* and to Venus the name of *Mandragoritis;* and the Emperor Julian, in his epistle to Calixenes, says, that he drinks the juice of mandrakes to excite amorous inclinations.

ATROPHY, in medicine, a disease, wherein the body, or some of its parts, does not receive the necessary nutriment, but waste and decay incessantly. See MEDICINE-*Index.*

ATROPOS, in fabulous history, the name of the third of the Parcæ, or Fates, whose business it was to cut the thread of life.

ATTACHMENT, in the law of England, implies the taking or apprehending a person by virtue of a writ or precept. It is distinguished from an *arrest,* by proceeding out of a higher court by precept or writ; whereas the latter proceeds out of an inferior court by precept only. An arrest lies only to the body of

Attachment || Attainder.

of a man; whereas an attachment lies often on the goods only, and sometimes on the body and goods. An attachment by writ differs from *distress*, in not extending to lands, as the latter does; nor does a distress touch the body, as an attachment does.

Attachment out of the Chancery, is obtained upon an affidavit made, that the defendant was served with a subpœna, and made no appearance; or it issues upon not performing some order or decree. Upon the return of this attachment by the sheriff, *qod non est inventus in balliva sua*, another attachment, with a proclamation, issues; and if he still refuses to appear, a commission of rebellion.

Attachment of the Forest, is one of the three courts held in the forest. The lowest court is called the *court of attachment*, or *wood-mote court*; the mean, *swanmote*; and the highest, the *justice in eyre's seat*. The court of attachments has its name from the verdurers of the forest having no other authority in it, but to receive the attachments of offenders against vert and venison taken by the foresters, and to enroll them, that they may be presented or punished at the next justice in eyre's seat. This attachment is by three means: by goods and chattels; by body, pledges, or mainprize; or by the body only. This court is held every 40 days throughout the year; and is thence called *forty day's court.*

Foreign Attachment is an attachment of money or goods found within a liberty or city, to satisfy some creditor within such liberty or city. By the custom of London, and several other places, a man can attach money or goods in the hands of a stranger, to satisfy himself.

ATTACK, a violent attempt upon any person or thing, an assault, or the act of beginning a combat or dispute.

Attack, in the military art, is an effort made to force a post, break a body of troops, &c.

Attack of a Seige, is a furious assault made by the besiegers with trenches, covers, mines, &c. in order to make themselves masters of a fortress, by storming one of its sides. If there are two or three attacks made at the same time, there should be a communication betwixt them. See War.

ATTACOTTI, an ancient people of Britain, mentioned by Ammianus, Marcellinus and St Jerome, as well as in the *Notitia Imperii*. They are represented as allies and confederates of the Scots and Picts, and therefore, probably their neighbours: though their precise situation has not been determined by antiquaries.

ATTAINDER, in law. When sentence of death, the most terrible and highest judgment in our laws, is pronounced, the immediate inseparable consequence by the common law is attainder. For when it is now clear beyond all dispute, that the criminal is no longer fit to live upon the earth, but is to be exterminated as a monster and a bane to human society, the law sets a note of infamy upon him, puts him out of its protection, and takes no farther care of him than barely to see him executed. He is then called *attaint*, *attinctus*, *stained*, or *blackened*. He is no longer of any credit or reputation; he cannot be a witness in any court; neither is he capable of performing the functions of another man: for, by an anticipation of his punishment, he is already dead in law. This is after judgment: for there is great difference between a man *convicted*, and *attainted*; though they are frequently through inaccuracy counfounded together. After conviction only, a man is liable to none of these disabilities: for there is still in contemplation of law a possibility of his innocence. Something may be offered in arrest of judgment: the indictment may be erroneous, which will render his guilt uncertain, and thereupon the present conviction may be quashed: he may obtain a pardon, or be allowed the benefit of clergy; both which suppose some latent sparks of merit, which plead in extenuation of his fault. But when judgment is once pronounced, both law and fact conspire to prove him completely guilty; and there is not the remotest possibility left of any thing to be said in his favour. Upon judgment, therefore, of death, and not before, the attainder of a criminal commences: or upon such circumstances as are equivalent to judgment of death; as judgment of outlawry on a capital crime, pronounced for absconding or fleeing from justice, which tacitly confesses the guilt: And therefore, upon judgment either of outlawry, or of death, for treason or felony, a man shall be said to be attainted.

Attainder, Attaint.

A person attainted of high treason forfeits all his lands, tenements, and heriditaments; his blood is corrupted, and he and his posterity rendered base; and this corruption of blood cannot be taken off but by act of parliament.*

* See the articles *Forfeiture* and *Corruption* of Blood.

Attainders may be reversed or falsified, (i. e. proved to be false) by writ or error, or by plea. If by writ of error, it must be by the king's leave, &c.; and when by plea, it may be by denying the treason, pleading a pardon by act of parliament, &c.

Persons may be attainted by act of parliament.—Acts of attainder of criminals have been passed in several reigns, on the discovery of plots and rebellions, from the reign of king Charles II. when an act was made for the attainder of several persons guilty of the murder of king Charles I. Among acts of this nature, that for attainting Sir John Fenwick, for conspiring against king William, is the most remarkable; it being made to attaint and convict him of high treason on the oath of one witness, just after a law had been enacted, "That no person should be tried or attainted of high treason where corruption of blood is incurred, but by the oath of two lawful witnesses, unless the party confess, stand mute, &c." Stat. 7 and 8 W. III. cap. 3. But in the case of Sir John Fenwick, there was something extraordinary; for he was indicted of treason on the oaths of two witnesses, tho' but only one could be produced against him on his trial.

ATTAINT, is a writ that lies after judgment against a jury of twelve men that have given false verdict in any court of record, in an action real or personal, where the debt or damages amount to above 40s. Stat. 5 and 34 Ed. III. c. 7. It is called *attaint*, because the party that obtains it endeavours thereby to stain or taint the credit of the jury with perjury, by whose verdict he is grieved.

The jury who are to try this false verdict must be twenty-four, and are called *the grand jury*; for the law wills

wills not that the oath of one jury of twelve men ſhould be attainted or ſet aſide by an equal number, nor by leſs indeed than double the former. And he that brings the attaint can give no other evidence to the grand jury, than what was originally given to the petit. For as their verdict is now trying, and the queſtion is whether or no they did right upon the evidence that appeared to them, the law adjudged it the higheſt abſurdity to produce any ſubſequent proof upon ſuch trial, and to condemn the prior juriſdiction for not believing evidence which they never knew. But thoſe againſt whom it is brought are allowed, in the affirmance of the firſt verdict, to produce new matter: becauſe the petit jury may have formed their verdict upon evidence of their own knowledge, which never appeared in court; and becauſe very terrible was the judgment which the common law inflicted upon them, if the grand jury found their verdict a falſe one. The judgment was, 1. That they ſhould loſe their *liberam legem*, and become for ever infamous. 2. That they ſhould forfeit all their goods and chattels. 3. That their lands and tenements ſhould be ſeized into the king's hands. 4. That their wives and children ſhould be thrown out of doors. 5. That their houſes ſhould be raſed and thrown down. 6. That their trees ſhould be rooted up. 7. That their meadows ſhould be ploughed. 8. That their bodies ſhould be caſt into jail. 9. That the party ſhould be reſtored to all that he loſt by reaſon of the unjuſt verdict. But as the ſeverity of this puniſhment had its uſual effect, in preventing the law from being executed, therefore by the ſtatute 11 Hen. VII. c. 24. revived by 23 Hen. VIII. c. 3. and made perpetual by 13 Eliz. c. 25. it is allowed to be brought after the death of the party, and a more moderate puniſhment was inflicted upon attainted jurors; viz. perpetual infamy, and if the cauſe of action were above L.40 value, a forfeiture of L.20 a-piece by the jurors; or, if under L.40, then L.5 a-piece; to be divided between the king and the party injured. So that a man may now bring an attaint either upon the ſtatute or at common law, at his election; and in both of them may reverſe the former judgment. But the practice of ſetting aſide verdicts upon motion, and granting new trials, has ſo superſeded the uſe of both ſorts of attaints, that there is hardly any inſtance of an attaint later than the 16th century.

Attaint, among farriers, a knock or hurt in a horſe's leg, proceeding either from a blow with another horſe's foot, or from an over-reach in froſty weather, when a horſe, being rough-ſhod, or having ſhoes with long caulkers, ſtrikes his hinder feet againſt his fore-leg.

ATTAINTED, in law, is applied to a perſon's being under attainder. See Attainder.

ATTALICÆ vestes, in antiquity, garments made of a kind of cloth of gold. They took the denomination from Attalus, ſurnamed Philometer, a wealthy king of Pergamus, who was the firſt, according to Pliny, who procured gold to be woven into cloth.

ATTALUS, the name of ſeveral kings of Pergamus. See Pergamus.

ATTELABUS, in zoology, a genus of inſects belonging to the order of coleoptera or beetle-kind. It has four wings, of which the ſuperior are cruſtaceous, and ſerve as a ſheath or cover to the inferior, which are membranous. The head tapers behind, and is inclined; the feelers turn thicker towards the apex. The ſpecies are 13; vix. 1. The coryli is black, with red elytra or cruſtaceous wings. 2. The avellana is black, with the breaſt, feet, and elytra red. 3. The curculionoides is black, with red elytra and breaſt. The above three ſpecies frequent the leaves of the hazel and filbert nut-trees. 4. The ſurinamenſis has a double indentation (or two teeth) in the top of the elytra. It is a native of Surinam. 5. The penſilvanicus is black, with red elytra, a black belt round the middle, and another towards the apex of the elytra. It is a native of Philadelphia. 6. The melanurus is black, with teſtaceous elytra, black at the apex. It is a native of Sweden. 7. The betula has ſaltatory or ſpringy legs, and the whole body is of a dark-red colour. It frequents the leaves of the birch-tree. 8. The formicarius is black, with red elytra, and a double white belt towards the baſe. It is a native of Europe. 9. The ſipylus is green, with a hairy breaſt, and a double yellow belt upon the elytra. 10. The apiarius is bluiſh, with red elytra, and three black belts. It is a native of Germany. 11. The mollis is yellowiſh and hairy, with pale elytra, and three belts. It is a native of Europe. 12. The ceramboides is of a blackiſh red colour, and the elytra is furrowed. It frequents the ſpongy beletus, a ſpecies of muſhroom. 13. The bupreſtoides is of a dark-red colour, with a globular breaſt, and nervous elytra. It is a native of Europe.

ATTENTION, a due application of the ear, or the mind, to any thing ſaid or done, in order to acquire a knowledge thereof. The word is compounded of *ad*, "to," and *tendo*, "I ſtretch."

Attention of mind is not properly an act of the underſtanding; but rather of the will, by which it calls the underſtanding from the conſideration of other objects, and directs it to the thing in hand. Nevertheleſs, our attention is not always voluntary: an intereſting object ſeizes and fixes it beyond the power of controul.

Attention, in reſpect of hearing, is the ſtretching or ſtraining of the *membrana tympani*, ſo as to make it more ſuſceptible of ſounds, and better prepared to catch even a feeble agitation of the air. Or it is the adjuſting the tenſion of that membrance to the degree of loudneſs or lowneſs of the ſound to which we are attentive.

According to the degree of attention, objects make a ſtronger or weaker impreſſion (A). Attention is requiſite

(A) Bacon, in his natural hiſtory, makes the following obſervations. "Sounds are meliorated by the intenſion of the ſenſe, where the common ſenſe is collected moſt to the particular ſenſe of hearing, and the ſight ſuſpended. Therefore ſounds are ſweeter, as well as greater, in the night than in the day; and I ſuppoſe they are ſweeter to blind men than to others; and it is manifeſt, that between ſleeping and waking, when all the ſenſes are bound and ſuſpended, muſic is far ſweeter than when one is fully waking."

Attention, Attenuants quisite even to the simple act of seeing: the eye can take in a considerable field at one look; but no object in the field is seen distinctly but that singly which fixes the attention: in a profound reverie that totally occupies the attention, we scarce see what is directly before us. In a train of perceptions, no particular object makes such a figure as it would do singly and apart; for when the attention is divided among many objects, no particular object is intitled to a large share. Hence, the stillness of night contributes to terror, there being nothing to divert the attention:

Horror ubique animos, simul ipsa silentia terrent. *Æn.* ii.

Zara. Silence and solitude are ev'ry where!
Through all the gloomy ways and iron doors
That hither lead, nor human face nor vice
Is seen or heard. A dreadful din was wont
To grate the sense, when enter'd here, from groans
And howls of slaves condemn'd, from clink of chains,
And crash of rusty bars and creaking hinges;
And ever and anon the sight was dash'd
With frightful faces, and the meagre looks
Of grim and ghastly executioners.
Yet more this stillness terrifies my soul
Than did that scene of complicated horrors.
Mourning Bride, act 5. sc. 3.

In matters of slight importance, attention is mostly directed by will; and for that reason, it is our own fault if trifling objects make any deep impression. Had we power equally to with-hold our attention from matters of importance, we might be proof against any deep impression. But our power fails us here: an interesting object seizes and fixes the attention beyond the possibility of controul; and while our attention is thus forcibly attached to one object, others may solicit for admittance; but in vain, for they will not be regarded. Thus a small misfortune is scarce felt in presence of a greater:

Lear. Thus think'st 'tis much, that this contentious storm
Invades us to the skin: so 'tis to thee:
But where the greater malady is fix'd,
The lesser is scarce felt. Thou'dst shun a bear;
But if thy flight lay tow'rd the roaring sea,
Thou'dst meet the bear i' th' mouth. When the mind's free,
The body's delicate: the tempest in my mind
Doth from my senses take all feeling else,
Save what beats there. *King Lear, act 3. sc. 5.*

ATTENUANTS, or ATTENUATING *Medicines*, are such as subtilize and break the humours into finer parts; and thus dispose them for motion, circulation, excretion, &c.

Attenuating and inciding medicines are of very extensive use in physic, and come under different denominations, according to the different effects they produce. Thus, when tenacious and viscid juices not only stagnate in the cavities of the vessels, but obstruct the minute ducts of the viscera and emunctories, these medicines, by the inciding and attenuating quality, discharge the humours, and remove the obstructions; for which reason they are not improperly called *aperients*.

Attenuants produce so great a variety of effects, that it is proper we should be well acquainted with their several kinds, as appropriated to the several disorders, and know which will prove most serviceable in each. According to Hoffman, the dissolving and attenuating of viscid crudities in the stomach and *primæ viæ*, is well answered by the roots of arum, acorus, pepper, ginger, and the like; as also by sal ammoniac, vitriolated tartar, the fixed alkaline salts, and the simple or dulcified spirit of salt. When crude and unconcocted humours are to be evacuated by stool, this intention is very well answered by the neutral salts, as the salts of the purging waters, and the *sal polycrestum*, with a sufficient quantity of watery vehicle.

Attenuants ‖ Atterbury.

When viscid humours, occasioning disorders of the breast, are to be attenuated and expectorated, the intention is most effectually answered by elecampane and orice roots; and by gum ammoniacum, myrrh, or benjamin, and balsam of Peru: or by regenerated tartar, oxymel of squills, a solution of crabs eyes in distilled vinegar, and the syrups of tabacco, and the like.

When the mass of blood is tainted by thick and tenacious sordes, and the emunctories are by that means obstructed, and the humours contaminated by a saline sulphureous and scorbutic dyscracy, the most efficacious of the attenuants are the horse-radish, scurvy-grass, water and garden cresses, mustard, gum ammoniacum, benjamin, myrrh, the oil of fixed nitre, oil of tartar *per deliquium*, solutions of nitre, spirit of sal ammoniac, salt of wormwood with lemon juice, and the salts of the medicinal waters.

When grumous or coagulated blood, occasioned by contusions or blows, is to be attenuated, and again dissolved, the intention is sure to be answered by the roots of Solomon's seal, vinegar, and crabs eyes, the regenerated tartar, and nitre prepared with antimony.

And in cases where the lymph has acquired a preternatural thickness and viscidity, especially if from a venereal taint, the curative intention is most effectually answered by guaiacum, the acrid tincture of antimony, calomel æthiops mineral, and the like; which, when skilfully used, are of singular efficacy in dissolving and attenuating the viscid juices impacted in the glands of the liver.

ATTENUATION, the act of attenuating; that is, of making any fluid thinner, and less consistent, than it was before. The word is compounded of *ad* 'to,' and *tenuis* 'thin.' Attenuation is defined more generally by Chauvin, the dividing or separating of the minute parts of any body, which before, by their mutual *nexus* or implication, formed a more continuous mass. Accordingly, among alchemists, we sometimes find the word used for pulverization, or the act of reducing a body into an impalpable powder, by grinding, pounding, or the like.

ATTERBURY (Dr Francis), son of Dr Lewis Atterbury, was born at Milton in Buckinghamshire, 1662; educated at Westminster; and from thence elected to Christ-Church in Oxford, where he soon distinguished himself by his fine genius and turn for polite literature. The year he was made M. A. 1687, he exerted himself in the controversy with the Papists, vindicated Luther in the strongest manner, and showed an uncommon fund of learning, enlivened with great vivacity. In 1690 he married Miss Osborn, a distant rela-

Atterbury. relation of the Duke of Leeds; a lady of great beauty, but with little or no fortune, who lived at or in the neigbourhood of Oxford.

In Feb. 1690-1, we find him resolved "to bestir himself in his office in the house;" that of censor probably, an officer (peculiar to Christ-church) who presides over the classical exercises; he then also held the catechetical lecture founded by Dr Busby.

About this period it must have been that he took orders, and entered into another scene, and another sort of conversation; for in 1691 he was elected lecturer of St Bride's church in London, and preacher at Bridewell chapel. An academic life, indeed, must have been irksome and insipid to a person of his active and aspiring temper. It was hardly possible that a clergyman of his fine genius, improved by study, with a spirit to exert his talents, should remain long unnoticed; and we find that he was soon after appointed chaplain to King William and Queen Mary.

The share he took in the controversy against Bentley (about the genuineness of the Phalaris Epistles) is now very clearly ascertained. In one of the letters to his noble pupil, dated "Chelsea 1693, (he says), the matter had cost him some time and trouble. In laying the design of the book, in writing above half of it, in reviewing a good part of the rest, in transcribing the whole, and attending the press (he adds), half a year of my life went away."

In 1700, a still larger field of activity opened, in which Atterbury was engaged four years with Dr Wake (afterwards Archbishop of Canterbury) and others, concerning the Rights, Powers, and Privileges of Convocations;" in which, however, the truth of the question may be supposed to lie, he displayed so much learning and ingenuity, as well as zeal for the interests of his order, that the Lower House of Convocation returned him their thanks, and the university of Oxford complimented him with the degree of D. D. January 29, 1700, he was installed archdeacon of Totness, being promoted to that dignity by Sir Jonathan Trelawny, then Bishop of Exeter. The same year he was engaged, with some other learned divines, in revising an intended edition of the "Greek Testament," with Greek "Scholia," collected chiefly from the fathers, by Mr Archdeacon Gregory. At this period he was popular as preacher at the Rolls Chapel; an office which had been conferred on him by Sir John Trevor, a great discerner of abilities, in 1698, when he resigned Bridewell, which he had obtained in 1693. Upon the accession of Queen Anne in 1702, Dr Atterbury was appointed one of her Majesty's chaplains in ordinary; and, in October 1704, was advanced to the deanery of Carlisle. About two years after this, he was engaged in a dispute with Mr Hoadly, concerning the advantages of virtue with regard to the present life; occasioned by his sermon, preached August 30, 1706, at the funeral of Mr Thomas Bennet, a bookseller. In 1707, Sir Jonathan Trelawny, then bishop of Exeter, appointed him one of the canons residentiaries of that church. In 1709, he was engaged in a fresh dispute with Mr Hoadly, concerning "Passive Obedience;" occasioned by his Latin Sermon, intitled "Concio ad Clerum Londinensem, habita in Ecclesia S. Elphegi." In 1710, came on the famous trial of Dr Sacheverell, whose remarkable speech on that occasion was generally supposed to have been drawn up by our author, in conjunction with Dr Smalridge and Dr Freind. The same year Dr Atterbury was unanimously chosen prolocutor of the Lower House of Convocation, and had the chief management of affairs in that House. May 11, 1711, he was appointed by the Convocation, one of the committee, for comparing Mr Whiston's doctrines with those of the church of England; and in June following, he had the chief hand in drawing up "A Representation of the Present State of Religion." In 1712, Dr Atterbury was made dean of Christ-Church, notwithstanding the strong interest and warm applications of several great men in behalf of his competitor Dr Smalridge. The next year saw him at the top of his preferment, as well as of his reputation: for, in the beginning of June 1713, the Queen, at the recommendation of Lord Chancellor Harcourt, advanced him to the bishopric of Rochester, with the deanery of Westminster in commendam; he was confirmed July 4, and consecrated at Lambeth next day.

At the beginning of the succeeding reign, his tide of prosperity began to turn; and he received a sensible mortification presently after the coronation of King George I. when, upon his offering to present his Majesty (with a view, no doubt, of standing better in his favour) with the chair of State and royal canopy, his own perquisites as dean of Westminster, the offer was rejected, not without some evident marks of dislike to his person.

During the rebellion in Scotland, when the Pretender's declaration was dispersed, the archbishop of Canterbury, and the bishops in and near London, had published a *Declaration of their Abhorrence of the present Rebellion, and an Exhortation to the Clergy and People to be zealous in the discharge of their duties to his Majesty King George:* but the Bishop of Rochester refused to sign it; and engaged bishop Smalridge in the same refusal, on account of some reflections it contained against the high-church party. He appeared generally among the protestors against the measures of the ministry under the king, and drew up the reasons of the protests with his own hand.

In 1716, we find him advising Dean Swift in the management of a refractory chapter. April 26, 1722, he sustained a severe trial in the loss of his lady; by whom he had four children; Francis, who died an infant; Osborn, student of Christ-Church; Elizabeth, who died September 29, 1716. aged 17; and Mary, who had been then seven years married to Mr Morrice.

In this memorable year, on a suspicion of his being concerned in a plot in favour of the Pretender, he was apprehended, August 24, and committed prisoner to the tower.

Two officers, the under-secretary, and a messenger, went about two o'clock in the afternoon to the Bishop's house in Westminster, where he then was, with orders to bring him and his papers, before the council. He happened to be in his night-gown when they came in: and being made acquainted with their business, he desired time to dress himself. In the mean time his secretary came in; and the officers went to search for his papers; in the sealing of which the messenger brought a paper, which he pretended to have found

Atterbury. found in his close-stool, and desired it might be sealed up with the rest. His Lordship observing it, and believing it to be a forged one of his own, desired the officers not to do it, and to bear witness that the paper was not found with him. Nevertheless they did it; and though they behaved themselves with some respect to him, they suffered the messengers to treat him in a very rough manner, threatening him, if he did not make haste to dress himself, they would carry him away undressed as he was. Upon which he ordered his secretary to see his papers all sealed up, and went himself directly to the Cock-pit, where the council waited for him. The behaviour of the messengers, upon this occasion, seems to have been very unwarrantable, if what the author of "a Letter to the Clergy of the Church of England," &c. tell us be be true, that the persons, directed by order of the King and council, to seize his Lordship and his papers, received a strict command to treat him with great respect and reverence. However this was, when he came before the council, he behaved with a great deal of calmness, and they with much civility towards him. He had liberty to speak for himself as much as he pleased, and they listened to his defence with a great deal of attention; and, what is more unusual, after he was withdrawn, he had twice liberty to re-enter the council-chamber, to make for himself such representations and requests as he thought proper. It is said, that, while he was under examination, he made use of our Saviour's answer to the Jewish council, while he stood before them; "If I tell you, ye will not believe me; and if I also ask you you, ye will not answer me, nor let me go." After three quarters of an hour's stay at the Cock-pit, he was sent to the Tower, privately, in his own coach, without any manner of noise or observation.

This commitment of a bishop, upon a suspicion of high treason, as it was a thing rarely practised since the Reformation, so it occasioned various speculations among the people. Those who were the Bishop's friends, and pretended to the greatest intimacy with him, laid the whole odium of the matter on the ministry. They knew the Bishop so well, they said, his love to our constitution, and attachment to the Protestant succession, his professed abhorence of Popery and settled contempt of the Pretender, and his caution, prudence, and circumspection, to be such as would never allow him to engage in an attempt of subverting the government, so hazardous in itself, and so repugnant to his principles; and therefore they imputed all to the malice and management of a great minister of state or two, who were resolved to remove him, on account of some personal prejudices, as well as the constant molestation he gave them in parliament, and the particular influence and activity he had shown in the late election. The friends to the ministry, on the other hand, were strongly of opinion, that the Bishop was secretly a favourer of the Pretender's cause, and had formerly been tampering with things of that nature, even in the Queen's time, and while his party was excluded from power; but upon their re-admission, had relinquished that pursuit, and his confederates therein, and became a good subject again. They urged, that the influence which the late Duke of Ormond had over him, assisted by his own private ambition and revenge, might prompt him to many things contrary to his declared sentiments, and inconsistent with that cunning and caution which in other cases he was master of. And to obviate the difficulty, arising from the Bishop's aversion to Popery, and the Pretender's bigotry to that religion, they talked of a new-invented scheme of his, not to receive the Pretender, whose principles were not to be changed, but his son only, who was to be educated a Protestant in the church of England, and the bishop to be his guardian, and Lord Protector of the kingdom, during his minority. These, and many more speculations, amused the nation at that time; and men, as usual, judged of things by the measure of their own affections and prejudices.

March 23. 1722-3 a bill was brought into the House commons, for "inflicting certain pains and penalties on Francis Lord bishop of Rochester;" a copy of which was sent to him, with notice that he had liberty of council and solicitors for making his defence. Under these circumstances the Bishop applied, by petition, to the House of Lords, for their direction and advice, as to his conduct in this conjuncture; and April 4, he acquainted the Speaker of the House of Commons, by a letter, that he was determined to give that house no trouble, in relation to the bill depending therein; but should be ready to make his defence against it when it should be argued in another House, of which he had the honour to be a member. On the 9th the bill passed the House of Commons, and was the same day sent up to the House of Lords for their concurrence.

May 6th, being the day appointed by the Lords for the first reading of the bill, Bishop Atterbury was brought to Westminster to make his defence. The counsel for the Bishop were, Sir Constantine Phipps, and William Wynne; Esq. for the King, Mr Reeve, and Mr Wearg. The proceedings continued above a week: and on Saturday May 11th, the Bishop was permitted to plead for himself. This he did in a very eloquent speech; which he feelingly opens by complaining of the uncommon severity he had experienced in the Tower; which was carried to so great a length, that not even his son-in-law Mr Morrice was permitted to speak to him in any nearer mode than standing in an open area, while the Bishop looked out of a two-pair-of-stairs window. In the course of his defence he observes, "Here is a plot of a year or two standing, to subvert the government with an armed force; an invasion from abroad, an insurrection at home: just when ripe for execution, it is discovered; and twelve months after the contrivance of this scheme, no consultation appears, no men corresponding together, no provision made, no arm, no officers provided, not a man in arms; and yet the poor bishop has done all this. What could tempt me to step thus out of my way? Was it ambition, and a desire of climbing into a higher station in the church? There is not a man in my office farther removed from this than I am. Was money my aim? I always despised it too much, considering what occasion I am now like to have for it: for out of a poor bishopric of L. 500 *per annum*, I have laid out no less than L. 1000 towards the repairs of the church and episcopal palace; nor did I take one shilling for dilapidations. The rest of my little income has been

Atterbury. spent, as is necessary, as I am a bishop. Was I influenced by any dislike of the established religion, and secretly inclined towards a church of greater pomp and power? I have, my lords, ever since I knew what Popery was, opposed it; and the better I knew it, the more I opposed it. I began my study in divinity, when the Popish controversy grew hot, with that immortal book of Tillotson's, when he undertook the Protestant cause in general; and as such, I esteemed him above all. You will pardon me, my lords, if I mention one thing: Thirty years ago, I writ in defence of Martin Luther; and have preached, expressed, and wrote to that purpose from my infancy; and whatever happens to me, I will suffer any thing, and, by God's grace, burn at the stake, rather than depart from any material point of the Protestant religion as professed in the church of England. Once more: Can I be supposed to favour arbitrary power? The whole tenor of my life has been otherwise: I was always a friend to the liberty of the subject; and, to the best of my power, constantly maintained it. I may have been thought mistaken in the measures I took to support it; but it matters not by what party I was called, so my actions are uniform." Afterwards, speaking of the method of proceeding against him as unconstitutional, he says: "My ruin is not of that moment to any number of men, to make it worth their while to violate, or even to seem to violate, the constitution in any degree, which they ought to preserve against any attempts whatsoever. Though I am worthy of no regard, though whatsoever is done to me may for that reason be looked upon to be just; yet your lordships will have some regard to your own lasting interest and that of posterity. This is a proceeding with which the constitution is unacquainted; which, under the pretence of supporting it, will at last effectually destroy it. For God's sake, lay aside these extraordinary proceedings; set not up these new and dangerous precedents. I, for my part, will voluntarily and cheerfully go into perpetual banishment, and please myself that I am in some measure the occasion of putting a stop to such precedents, and doing some good to my country: I will live, wherever I am, praying for its prosperity; and do, in the words of Father Paul to the state of Venice, say, *Esto perpetua*. It is not my departing from it I am concerned for. Let me depart, and let my country be fixed upon the immoveable foundation of law and justice, and stand for ever."—After a solemn protestation of his innocence, and an appeal to the Searcher of Hearts for the truth of what he had said, he concludes thus: "If, on any account, there shall still be thought by your lordships to be any seeming strength in the proofs against me; if, by your lordships judgments, springing from unknown motives, I shall be thought to be guilty; if, for any reasons or necessity of state, of the wisdom and justice of which I am no competent judge, your lordships shall proceed to pass this bill against me; I shall dispose myself quietly and tacitly to submit to what you do; God's will be done: Naked came I out of my mother's womb, and naked shall I return; and whether he gives or takes away, blessed be the name of the Lord!"

On Monday the 13th he was carried for the last time from the Tower to hear the reply of the King's counsel to his defence. These were both men of great knowledge and sagacity in law, but of different talents in point of eloquence. Their speeches on this occasion were made public; and they seem to have formed their "Replies," designedly, in a different way. The former sticks close to the matter in evidence, and enforces the charge against the Bishop with great strength and perspicuity: The latter answers all his objections, and refutes the arguments brought in his defence, in an easy soft manner, and with great simplicity of reasoning. Mr. Reeve is wholly employed in facts, in comparing and uniting together circumstances, in order to corroborate the proofs of the Bishop's guilt: Mr Wearg is chiefly taken up in silencing the complaints of the Bishop and his counsel, and replying to every thing they advance, in order to invalidate the allegations of his innocence. The one, in short, possesses the minds of the Lords with strong convictions against the Bishop: The other dispossesses them of any favourable impression that might possibly be made upon them by the artifice of his defence. And accordingly Mr Reeve is strong, nervous, and enforcing; but Mr Wearg, smooth, easy, and insinuating, both in the manner of his expression and the turn of his periods. Mr Wearg pays the highest compliments to the Bishop's eloquence: but, at the same time, represents it as employed to impose upon the reason, and misguide the judgment of his hearers, in proportion as it affected their passions; and he endeavours to strip the Bishop's defence of all its ornaments and colours of rhetoric.

On the 15th the bill was read the third time; and, after a long and warm debate, passed on the 16th, by a majority of 83 to 43. On the 27th the King came to the House, and confirmed it by his royal assent. June 18. 1723, this eminent Prelate, having the day before taken leave of his friends, who, from the time of passing the bill against him to the day of his departure, had free access to him in the Tower (B), embarked on board the Aldborough man of war, and landed

(B) The following anecdote was first communicated to the public by the late Dr Maty, on the credit of Lord Chesterfield: "I went (said Lord Chesterfield) to Mr Pope, one morning, at Twickenham, and found a large folio Bible, with gilt clasps, lying before him upon his table; and, as I knew his way of thinking upon that book, I asked him, jocosely, if he was going to write an answer to it? It is a present, said he, or rather a legacy, from my old friend the Bishop of Rochester. I went to take my leave of him yesterday in the Tower, where I saw this Bible upon his table. After the first compliments, the Bishop said to me, 'My friend Pope, considering your infirmities, and my age and exile, it is not likely that we should ever meet again; and therefore I give you this legacy to remember me by it. Take it home with you; and let me advise you to abide by it.'—'Does your Lordship abide by it yourself?'—'I do.'—'If you do, my Lord, it is but lately. May I landed the Friday following at Calais. When he went on ſhore, having been informed that Lord Bolingbroke, who had after the riſing of the parliament, received the King's pardon, was arrived at the ſame place on his return to England, he ſaid, with an air of pleaſantry, "Then I am exchanged!" and it was, in the opinion of Mr Pope, on the ſame occaſion, "a ſign of the nation's being curſedly afraid of being over-run with too much politeneſs, when it could not regain one great man, but at the expence of another." But the ſeverity of his treatment did not ceaſe even with his baniſhment. The ſame vindictive ſpirit purſued him in foreign climes. No Britiſh ſubject was even permitted to viſit him without the king's ſign manual, which Mr Morice was always obliged to ſolicit, not only for himſelf, but for every one of his family whom he carried abroad with him, for which the fees of office were very high.

When biſhop Atterbury firſt entered upon his baniſhment, Bruſſels was the place deſtined for his reſidence; but, by the arts and inſtigations of the Britiſh miniſters, he was compelled to leave that place, and retire to Paris. There being ſolicited by the friends of the Pretender to enter into their negociations, he changed his abode for Montpelier in 1728; and, after reſiding there about two years, returned to Paris, where he died Feb. 15. 1731-2. The affliction which he ſuſtained by the death of his daughter in 1729, was thought to have haſtened his own diſſolution. The former event he hath himſelf related in a very affecting manner, in a letter to Mr. Pope: "The earneſt deſire of meeting one I dearly loved, called me abruptly to Montpelier; where, after continuing two months under the cruel torture of a ſad and fruitleſs expectation, I was forced at laſt to take a long journey to Toulouſe; and even there I had miſſed the perſon I ſought, had ſhe not, with great ſpirit and courage, ventured all night up the Garonne to ſee me, which ſhe above all things deſired to do before ſhe died. By that means ſhe was brought where I was, between ſeven and eight in

I beg to know what new light or arguments have prevailed with you now, to entertain an opinion ſo contrary to that which you entertained of that book all the former part of your life?'—The Biſhop replied, 'We have not time to talk of theſe things; but take home the book; I will abide by it, and I recommend you to do ſo too; and ſo God bleſs you.'

Theſe anecdotes Mr Nichols has inſerted in the "Epiſtolary Correſpondence," Vol. II. p. 79. with the profeſſed view of vindicating Atterbury, in the following words of an ingenius correſpondent:

"Dr Warton hath revived this ſtory, which he juſtly calls an 'uncommon' one, in his laſt 'Eſſay on the Genius and Writings of Pope.' It was indeed very uncommon; and I have my reaſons for thinking it equally groundleſs and invidious. Dr Warton, though he retails the ſtory from 'Maty's Memoirs,' yet candidly acknowledges, that it ought not to be implicitly relied on. That this caution was not unneceſſary, will, I apprehend, be ſufficiently obvious, from the following compariſon between the date of the ſtory itſelf and Mr Pope's letters to the Biſhop.

"According to Lord Cheſterfield's account, this remarkable piece of converſation took place but a few days before the Biſhop went into exile: and it is inſinuated that Mr Pope, till that period, had not even entertained the ſlighteſt ſuſpicion of his friend's reverence for the Bible: Nay, it is aſſerted, that the very recommendation of it from a quarter ſo unexpected, ſtaggered Mr Pope to ſuch a degree, that in a mingled vein of raillery and ſeriouſneſs, he was very eager to know the grounds and reaſons of the Biſhop's change of ſentiment.

"Unfortunately for the credit of Lord Cheſterfield and his ſtory, there is a letter on record, that was written nine months before this pretended dialogue took place, in which Mr Pope ſeriouſly acknowledged the Biſhop's piety and generoſity, in intereſting himſelf ſo zealouſly and affectionately in matters which immediately related to his improvement in the knowledge of the holy ſcriptures. The paſſage I refer to is a very remarkable one: and you will find it in a letter, dated July 27. 1722. It appears undeniably from this letter, that the Biſhop had earneſtly recommended to Mr Pope the ſtudy of the Bible; and had ſoftened his zeal with an unuſual urbanity and courteſy, in order to avoid the imputation of ill-breeding, and remove all occaſion of diſguſt from a mind ſo 'trembling alive' as Mr Pope's. I will tranſcribe the paſſage at large. 'I ought firſt to prepare my mind for a better knowledge even of good profane writers, eſpecially the moraliſts, &c. before I can be worthy of taſting the Supreme of books, and Sublime of all writings, in which, as in all the intermediate ones, you may (if your friendſhip and charity towards me continue ſo far) be the beſt guide to, Yours, A. Pope.'

"The laſt letter of Mr Pope to the Biſhop, previous to his going into exile, was written very early in June 1723. It muſt have been about this time that Pope paid his farewel viſit to the Biſhop in the Tower. But whether ſuch a converſation as that which hath been pretended actually took place, may be left to the determination of every man of common ſenſe, after comparing Lord Cheſterfield's anecdote with Mr. Pope's letter.

"There muſt have been a miſtake, or a wilful miſrepreſentation ſomewhere. To determine its origin, or to mark minutely the various degrees of its progreſs, till it iſſued forth into calumny and falſehood, is impoſſible. I have ſimply ſtated matters of fact as they are recorded; and leave it to your readers to ſettle other points not quite ſo obvious and indiſputable, as they may think fit. My motives in this very plain relation aroſe from an honeſt wiſh to remove unmerited obloquy from the dead. I ſhould ſincerely rejoice if the cloud which in other reſpects ſtill ſhades the character of this ingenious Prelate could be removed with equal facility and ſucceſs. I am, dear Sir, your faithful humble ſervant, Samuel Badcock."

Atterbury. in the morning, and lived 20 hours afterwards; which time was not loſt on either ſide, but paſſed in ſuch a manner as gave great ſatisfaction to both, and ſuch as, on her part, every way became her circumſtances and character: For ſhe had her ſenſes to the very laſt gaſp, and exerted them to give me, in thoſe few hours, greater marks of duty and love than ſhe had done in all her lifetime, though ſhe had never been wanting in either. The laſt words ſhe ſaid to me were the kindeſt of all; a reflection on the goodneſs of God, which had allowed us in this manner to meet once more, before we parted for ever. Not many minutes after that, ſhe laid herſelf on her pillow, in a ſleeping poſture.

Placidaque ibi demum morte quievit.

Judge you, Sir, what I felt, and ſtill feel on this occaſion, and ſpare me the trouble of deſcribing it. At my age, under my infirmities, among utter ſtrangers, how ſhall I find out proper reliefs and ſupports? I can have none, but thoſe with which reaſon and religion furniſh me; and thoſe I lay hold on, and graſp as faſt as I can. I hope that he who laid the burden upon me (for wiſe and good purpoſes no doubt) will enable me to bear it in like manner as I have borne others, with ſome degree of fortitude and firmneſs."

How far the Biſhop might have been attached in his inclinations to the Stuart family, to which he might be led by early prejudices of education, and the divided opinions of the times, it is not neceſſary here to enquire: But that he ſhould have been weak enough to engage in a plot ſo inconſiſtent with his ſtation, and ſo clumſily deviſed (to ſay the leaſt of it, and without entering into his ſolemn aſſeveration of innocence), is utterly inconſiſtent with that cunning which his enemies allowed him. The Duke of Wharton, it is well known, was violent againſt him, till convinced by his unanſwerable reaſoning.

It has been ſaid that Atterbury's wiſhes reached to the biſhopric of London, or even to York or Canterbury. But thoſe who were better acquainted with his views, knew that Wincheſter would have been much more deſirable to him than either of the others. And there are thoſe now living, who have been told from reſpectable authority, that that biſhopric was offered to him whenever it ſhould become vacant (and till that event ſhould happen a penſion of L.5000 a-year, beſides an ample proviſion for Mr Morice), if he would ceaſe to give the oppoſition he did to Sir Robert Walpole's adminiſtration, by his ſpeeches and proteſts in the Houſe of Lords. When that offer was rejected by the Biſhop, then the contrivance for his ruin was determined on.

In his ſpeech in the Houſe of Lords, the Biſhop mentions his being "engaged in a correſpondence with two learned men (Biſhop Potter and Dr Wall), on ſettling the times of writing the four goſpels." Part of this correſpondence is ſtill in being, and will ſoon be publiſhed. The ſame ſubject the Biſhop purſued during his exile, having conſulted the learned of all nations, and had nearly brought the whole to a concluſion when he died. Theſe laudable labours are an ample confutation of Biſhop Newton's aſſertion, that Atterbury "wrote little whilſt in exile but a few criticiſms on French authors."

His body was brought over to England, and interred on the 12th of May following in Weſtminſter abbey, in a vault which in the year 1722 had been prepared by his directions. There is no memorial over his grave: nor could there well be any, unleſs his friends would have conſented (which it is moſt probable they refuſed to do) that the words implying him to have died biſhop of Rocheſter ſhould have been omitted on his tomb. Atterbury.

Some time before his death, he publiſhed a vindication of himſelf, Biſhop Smalridge, and Dr Aldrich, from a charge brought againſt them by Mr Oldmixon, of having altered and interpolated the copy of Lord Clarendon's "Hiſtory of the Rebellion." Biſhop Atterbury's "Sermons" are extant in four volumes in octavo: thoſe contained in the two firſt were publiſhed by himſelf, and dedicated to his great patron Sir Jonathan Trelawny biſhop of Wincheſter; thoſe in the two laſt were publiſhed after his death by Dr Thomas Moore his Lordſhip's chaplain. Four admirable "Viſitation Charges" accompany his "Epiſtolary Correſpondence."

As to Biſhop Atterbury's character, however the moral and political part of it may have been differently repreſented by the oppoſite parties, it is univerſally agreed, that he was a man of great learning and uncommon abilities, a fine writer, and a moſt excellent preacher. His learned friend Smalridge, in the ſpeech he made when he preſented him to the Upper Houſe of Convocation, as prolocutor, ſtyles him *Vir in nullo literarum genere hoſpes, in pleriſque artibus et ſtudiis diu et feliciter exercitatus, in maxime perfectis literarum diſciplinis perfectiſſimus.* In his controverſial writings, he was ſometimes too ſevere upon his adverſary, and dealt rather too much in ſatire and invective: but this his panegyriſt imputes more to the natural fervour of his wit than to any bitterneſs of temper or prepenſe malice. In his ſermons, however, he is not only every way unexceptionable, but highly to be commended. The truth is, his talent as a preacher was ſo excellent and remarkable, that it may not improperly be ſaid, that he owed his preferment to the pulpit; nor any hard matter to trace him, through his writings, to his ſeveral promotions in the church. We ſhall conclude Biſhop Atterbury's character, as a preacher, with the encomium beſtowed on him by the author of "the Tatler;" who, having obſerved that the Engliſh clergy too much neglect the art of ſpeaking, makes a particular exception with regard to our prelate; who, ſays he, "has ſo particular a regard to his congregation, that he commits to his memory what he has to ſay to them; and has ſo ſoft and graceful a behaviour, that it muſt attract your attention. His perſon (continues this author), it is to be confeſſed, is no ſmall recommendation; but he is to be highly commended for not loſing that advantage, and adding to propriety of ſpeech (which might paſs the criticiſm of Longinus) an action which would have been approved by Demoſthenes. He has a peculiar force in his way, and has many of his audience, who could not be intelligent hearers of his diſcourſe were there no explanation as well as grace in his action. This art of his is uſed with the moſt exact and honeſt ſkill. He never attempts your paſſions, till he has convinced your reaſon. All the objections which you can form are laid open and diſperſed before he uſes the leaſt vehemence

hemence in his sermon; but when he thinks he has your head, he very soon wins your heart, and never pretends to show the beauty of holiness, till he has convinced you of the truth of it."—In his letters to Pope, &c. Bishop Atterbury appears in a pleasing light, both as a writer and as a man. In ease and elegance they are superior to those of Pope, which are more studied. There are in them several beautiful references to the classics. The Bishop excelled in his allusions to sacred as well as profane authors.

ATTESTATION, the act of affirming or witnessing the truth of something, more especially in writing.

ATTIC, any thing relating to Attica, or to the city of Athens: thus Attic salt, in philology, is a delicate poignant sort of wit and humour peculiar to the Athenian writers; Attic witness, a witness incapable of corruption, &c.

Attic Order. See ARCHITECTURE.

Attic Base, a peculiar kind of base used by the ancient architects in the Ionic order; and by Palladio, and some others, in the Doric.

Attic Story, in architecture; a story in the upper part of a house, where the windows are usually square.

1 Boundaries extent, &c.

ATTICA, an ancient kingdom of Greece, situated along the north coast of the gulph of Saron, bounded on the west by Megara, mount Cithæron, and part of Bœotia; on the north by the gulph of Euripus, now *Stretto di negro ponte*, and the rest of Bœotia; and on the east by the Europius. It extended in length from north-west to south-east about 60 miles; its breadth from north to south was 56, decreasing as it approached the sea.

2 Inhabitants thought to be produced from the soil.

The soil of this country was naturally barren and craggy, though by the industry of its inhabitants it produced all the necessaries of life. On this account Attica was less exposed to invasions than other more fertile countries; and hence it preserved its ancient inhabitants beyond all the other kingdoms in its neighbourhood; so that they were reputed to be the spontaneous productions of the soil; and as a badge of this, Thucydides tells us, they wore golden grasshoppers in their hair.

3 Cities.

The chief cities in the kingdom of Attica were Athens the capital; next to it Eleusis, situated on the same gulph, near the coasts of Megara; and next to that Rhamnus, famed for the temple of Amphiaraus and the statue of the goddess Nemesis.

4 Cecrops the first king.

The first king of this country, of whom we have any distinct account, was Cecrops. Others indeed are said to have reigned before him, particularly one Actæus, whose daughter Cecrops married, and in her right laid the foundation of his new monarchy. Cecrops is said to have been the first who deified Jupiter, set up altars and idols, and instituted marriage among the Greeks. He is likewise affirmed to have taught his subjects navigation; and for the better administration of justice, and promoting intercourse among them, to have divided them into the first four tribes, called *Cecropis*, *Autochton*, *Actea*, and *Paralia*; and he is also by some said to be the founder of the Areopagus. From this monarch the Athenians affected to call themselves *Cecropidæ* till the reign of Erectheus their sixth king, after whom they took the name of *Erecthydæ*.

5 Cranaus.

Cecrops dying after the reign of 50 years, left three daughters; by marrying one of which, probably, Cranaus a wealthy citizen ascended the throne. He enjoyed his crown peaceably for ten years; till, having married one of his daughters, named *Attis*, to Amphictyon the son of Deucalion, he was by him dethroned, and forced to lead a private life to the last. From this daughter, the country, which before had been called *Actea*, took the name of *Attica*.

6 Whence the country was called Attica.

7 Ericthonius.

After a reign of 10 or 12 years, Amphictyon was himself deposed by Ericthonius, said to be the son of Vulcan and Tethys. Being lame of both his feet, he is said to have invented coaches, or, as others will have it, instituted horse and chariot races in honour of Minerva. He is also reported to have been the first who stamped silver coin. He reigned 50 years, and was succeeded by his son Pandion the father of Progne and Philomela; whose hard fate, so famous among the poets, is supposed to have broke his heart, after a reign of about 40 years. In his time Triptolemus taught the Athenians agriculture, which he had learned from Ceres.

8 Pandion.

9 Erectheus.

Pandion was succeeded by his son Erectheus, who being reckoned the most powerful prince of his time, Boreas king of Thrace demanded his daughter Orithia in marriage, and on being refused carried her off by force. After a reign of 50 years, Erectheus being killed in a battle with the Eleusians, was succeded by his son Cecrops II. who is generally allowed to have been the first who gathered the people into towns; they having till then lived in houses and cottages scattered here and there, without order or regular distance. After a reign of 40 years he was driven out by his brethren Metion and Pandorus, who forced him to fly into Ægialea, where he died.

10 Cecrops II.

11 Pandion II.

Cecrops II. was succeeded by his son Pandion II. and he was likewise driven out by Metion, who assumed the government. Pandion in the mean time fled into Megara, where he married Pelia the daughter of Pylas king of that place, and was appointed successor to the kingdom. Here he had four sons, who returning to Athens, whether with or without their father is uncertain, expelled the sons of Metion, and after the decease of Pandion their father, divided the government among themselves; notwithstanding which the royal dignity did in effect remain with Ægeus the eldest.

12 Ægeus.

Ægeus, when he ascended the throne, finding himself despised by his subjects because he had no sons, and sometimes insulted by his brother Pallas, who had no less than fifty, consulted the oracle of Apollo at Delphi. Receiving here, as was commonly the case, an answer which could not be understood without a commentator, he applied to Pittheus king of Troezen, famous for his skill in expounding oracles. This prince easily prevailed with him to lie with his daughter Æthra, who proved with child; and as none but these three were privy to the secret, Ægeus, before his return to Athens, hid a sword and a pair of shoes under a stone, leaving orders with the princess, that if the child proved a boy, she should send him to Athens with these tokens as soon as he was able to lift up that stone. He charged her moreover to use all imaginable secrecy, lest the sons of his brother Pallas should way-lay and murder him.

13 Theseus born.

Æthra being delivered of a son, Pittheus gave out that Neptune was the father of it. This child was named *Theseus*, and proved one of the most famous heroes of antiquity. Being arrived at the age of 16, his mother brought him to the stone abovementioned; and he having lifted it with ease, was desired to take up the sword and shoes and prepare himself to go to his father. He was advised to go by sea rather than by land, as, ever since the departure of Hercules, the roads had been exceedingly infested by banditti. Theseus, however, who had already begun to discover marks of uncommon strength and courage, no sooner heard the name of Hercules mentioned, than he became desirous of imitating so great a pattern; and after performing a number of glorious exploits, for which see the article Theseus, he arrived safe at his father's capital.

14 Is made known to his father.

The great atchievements of our young hero procured him a welcome reception at the court of Ægeus, though his birth was unknown to all except Medea, to whom the king had lately been married. This queen being a sorceress, it is not to be supposed any thing could be concealed from her: she therefore, by her diabolical penetration, quickly found out that Theseus was the king's son; after which she became so jealous of him on account of his valour, that she persuaded her old husband to invite the young stranger to a banquet, and poison him in a glass of wine. The poison was accordingly prepared, and Theseus invited; but the prince suddenly drawing his sword, it was immediately recognized by Ægeus to be the same he had formerly buried below the stone. Upon this he stepped forward to Theseus, throwing down the poisoned draught in his way; and, embracing him with much tenderness, owned him for his son before all the court.

At this time the king of Athens had great occasion for such a champion as Theseus. The sons of Pallas, who had all along behaved with great insolence, upon Theseus being discovered to be the king's son, and heir apparent to the crown, broke out in open rebellion. They were soon discomfited; but Ægeus and the whole country of Attica were still in great distress on the following account. Some years before, Androgeus, the son of Minos king of Crete, came to Athens to be present at one of their feasts. During this visit he contracted such an intimacy with the fifty sons of Pallas, that Ægeus fearing some fatal consequences, caused him to be privately murdered. According to others, Androgeus having undertaken to encounter the Marathonian bull, was killed by it. Be this as it will, Minos having received news of his son's death, imputed it to the people of Attica; and therefore, after several unsuccessful attempts to revenge his own quarrel, prayed to the gods to do it for him. The Athenians, in consequence of this prayer, were visited with earthquakes, famine, and pestilence; on account of which they applied to the oracle. Here they were informed, that no relief was to be had till they were reconciled to the Cretan king. Minos resolving to make them pay dear for their deliverance, imposed upon them a tribute of seven young men and as many virgins, whom he condemned to be devoured by the Minotaur, a monster feigned by the poets to have been half man and half bull. This bloody tribute had been twice paid, and Minos had already sent his messengers the third time, when Theseus willingly offered himself to be one of the unhappy victims; and embarking with them in one ship, he gave the pilot two sails, the one black to sail with, and the other white to be hoisted up at his return in case he came off victorious.

15 He kills the Minotaur.

Our hero had all the success he could wish: he killed the Minotaur, prevailed with Minos to remit the tribute, and his daughter Ariadne to run away with him; but her he left with child in the isle of Naxos.

16 Death of Ægeus.

Unfortunately, however, for Ægeus, the joy of Theseus and his company was so great, that at their return they forgot to hoist the white flag in token of their victory: upon which the old king, taking for granted that his son was killed, threw himself into the sea, which ever since has from him been called the *Ægean Sea*.

17 Theseus king of Attica.

Theseus being thus left in possession of the kingdom of Attica, began immediately to think of indulging his warlike genius, and rendering the civil affairs of his kingdom as little troublesome as possible.

18 New models the government.

To accomplish this purpose, he began with gathering most of the people of Attica into the old and new town, which he incorporated into one city. After this he divested himself of all his regal power, except the title of king, the command of the army, and the guardianship of the laws. The rest he committed to proper magistrates chosen out of three different orders of the people, whom he divided into nobles, husbandmen, and artificers. The first he invested with the power of interpreting and executing the laws, and regulating whatever related to religion. The other two chose their inferior magistrates from among themselves, to take care of whatever related to their separate orders: so that the kingdom was in some measure reduced to a commonwealth, in which the king had the greatest post, the nobles were next to him in honour and authority, the husbandmen had the greatest profit, and the artists exceeded them in number. He likewise abolished all their distinct courts of judicature, and built one common council-hall called *Prytaneum*, which stood for many ages afterwards.

Having thus new-modelled the government, his next care was to join to his dominions the kingdom of Megara, in right of his grandfather Pandion II. who had married the daughter of Pylas, as abovementioned. On this occasion he erected the famous pillar in the isthmus, which showed the limits of the two countries that met there. On the one side of this pillar was inscribed, "This is not Peloponnesus, but Ionia;" and on the other, "This is Peloponnesus, not Ionia."

19 Defeats the Amazons, kills the Centaurs, and carries off Helena.

After this he undertook an expedition against the Amazons, whom he overcame, took their queen Hippolita, and afterwards married her. Soon after this, Theseus contracted an intimacy with Perithous the son of Ixion; and being invited to his nuptials, assisted him in killing a number of Centaurs, or rather Thessalian horsemen (who in their cups had offered violence to their female guests), and drove the rest out of the country. Our two associates then proceeded to Sparta, where Theseus fell in love with the famed Helena, at that time not above nine years old, while he himself was upwards of fifty. Her they carried off: and of the rape there are various accounts; but the following one, which is given by Plutarch, is generally allowed to be the most authentic.

According to that historian, they stole this beauty, the greatest in the world at this time, out of the temple of Diana Ortia, where Helena happened to be dancing. They were pursued as far as Tegea, but made

their

Attica.

their eſcape out of Peloponneſus; and thinking themſelves now ſecure of their prey, they agreed to caſt lots for her, upon condition that he to whoſe lot ſhe fell ſhould aſſiſt the other in procuring ſome celebrated beauty. Fortune having declared for Theſeus, he aſſiſted his companions in the like attempt upon Proſerpina daughter of Aidonius king of the Molloſſi in Epirus; who, being the next beauty to Helena, was guarded by the dog Cerberus, which had three heads, and was conſequently a very formidable enemy. Her father, however, underſtanding that they deſigned to ſteal away his daughter, threw Perithous to be torn in

20 Impriſoned by the king of Epirus.

pieces by Cerberus, and put Theſeus in priſon, from whence he was afterwards relieved at the interceſſion of Hercules.

After this misfortune, Theſeus at length returned to Athens, but found himſelf very coolly received by his ſubjects. Mneſtheus, the ſon of Peteus, and great-grandſon of Erectheus, had made uſe of the king's abſence to ingratiate himſelf with the people; and upon the commencment of a war with Caſtor and Pollux, the two brothers of Helena, he perſuaded the people of Athens to open their gates to the two brothers. Up-

21 Driven out of Athens.

on this, Theſeus was under the neceſſity of conveying away himſelf and family with all poſſible privacy. This he luckily accompliſhed; and deſigned to have ſailed to Crete, to have obtained aſſiſtance from Deucalion ſon of Minos, and now brother-in-law to Theſeus himſelf, he having lately married Phædra ſiſter to Deucalion. Unfortunately, however, our hero was ſhipwrecked on the iſland of Scyros. Here he he was at firſt kindly re-

22 His death.

ceived by Lycomedes the king of that iſland, but was ſoon after killed by a fall from a high rock, over which ſome ſay he was puſhed by Lycomedes himſelf, who had been prevailed upon to deſtroy Theſeus in that manner by Mneſtheus, that he might with the more ſecurity enjoy the kingdom of Athens.

23 Mneſtheus, Demophon, &c.

Mneſtheus reigned 24 years, but loſt his life at the ſiege of Troy; and was ſucceeded by Demophon one of the ſons of Theſeus by Phædra, who was likewiſe at the ſiege of Troy, but had the good fortune to return in ſafety. In his reign was erected the famous court of the Ephetæ; conſiſting originally of 50 Athenians and as many Argives, for trying of wilful murders. By this court the king himſelf afterwards ſubmitted to be tried for having accidentally killed one of his ſubjects. He reigned 33 years, and was ſucceeded by his ſon, according to ſome, or according to others his brother, Oxyntes, who reigned 12 years. Oxyntes was ſucceeded by his ſon Aphydas, who was murdered by Thymætes the baſtard ſon of Oxyntes.

24 Thymætes depoſed.

This king diſcovered many baſe qualities unworthy of his dignity; and at laſt was depoſed by his ſubjects on the following occaſion. Xanthus king of Bœotia had a conteſt with the Athenians about one of their frontier towns. He offered to decide the matter by ſingle combat with the king; but this was declined by Thymætes. It happened, that at that time one Melanthus a Meſſenian, who had been driven out of his country by the Heraclidæ, was come to Athens; who accepted the king of Bœotia's challenge. At the firſt onſet, Melanthus aſked his adverſary, why he had, contrary to the articles, brought a ſecond into the field with him? and as Xanthus immediately looked about to ſee who was behind him, Melanthus run him through with his lance. The victory, though it did little honour to him who gained it, was ſo agreeable to the Athenians, that they depoſed their cowardly king Thymætas, after he had reigned 8 years; and appointed Melanthus in his ſtead, who after a reign of 37 years left the kingdom to his ſon Codrus.

25 Melanthus

This prince reigned about 21 years; during which time the Dores and Heraclidæ had regained all Peloponneſus, and were upon the point of entering into Attica. Codrus, being informed that the oracle had promiſed them victory provided they did not kill the king of the Athenians, came immediately to a reſolution of dying for his country. Diſguiſing himſelf, therefore, like a peaſant, he went into the enemy's camp, and, quarrelling with ſome of the ſoldiers, was killed by them. On the morrow, the Athenians knowing what was done, ſent to demand the body of their king; at which the invaders were ſo terrified, that they decamped without ſtriking a blow.

26 Codrus the laſt king ſacrifices himſelf for his country

Upon the death of Codrus, a diſpute which happened among his ſons concerning the ſucceſſion, furniſhed the Athenians with a pretence for ridding themſelves of their kings altogether, and changing the monarchial form of government into a republican one. It was improbable, they ſaid, that they ſhould ever have ſo good a king as Codrus; and to prevent their having a worſe, they reſolved to have no king but Jupiter. That they might not, however, ſeem ungrateful to the family of Codrus, they made his ſon Medon their ſupreme magiſtrate, with the title of *archon*. They afterwards rendered that office decennial, but continued it ſtill in the family of Codrus. The extinction of the Medontidæ at laſt left them without reſtraint; upon which they not only made this office annual, but created nine archons. By the latter invention they provided againſt the too great power of a ſingle perſon, as by the former they took away all apprehenſion of the archons having time to eſtabliſh themſelves, ſo as to change the conſtitution. In a word, they now attained what they had long ſought, viz. the making the ſupreme magiſtrates dependent on the people.

27 Republican government introduced.

We have a liſt of theſe archons for upwards of 600 years, beginning with Creon, who lived about 684 years before Chriſt, to Herodes, who lived only 60 years before that time. The firſt archon of whom we hear any thing worth notice, is named *Draco*. He reigned in the ſecond, or, as others ſay, in the laſt year of the 39th Olympiad, when, it is ſuppoſed, he publiſhed his laws: but though his name is very frequently mentioned in hiſtory, yet no connected account can be found either of him or his inſtitutions; only, in general, his laws were exceedingly ſevere, inflicting death for the ſmalleſt faults; which gave occaſion to one Demades an orator to obſerve, that the laws of Draco were written with blood, and not with ink. For this extraordinary ſeverity he gave no other reaſon, than that ſmall faults ſeemed to him to be worthy of death, and he could find no higher puniſhment for the greateſt. He was far advanced in years when he gave laws to Athens; and to give his inſtitutions the greater weight, he would not ſuffer them to be called *nomoi*, or laws, but *theſmoi*, or ſanctions proceeding from more than human wiſdom. The extreme ſeverity of theſe laws, however, ſoon made the Athenians weary both of them and the author of them; upon which Draco was obliged

28 Draco legiſlator of Athens.

29 Expelled the city.

Attica.

obliged to retire to Ægina. Here he was received with the highest honours: but the favour of the inhabitants of this place proved more fatal to him than the hatred of the Athenians; for coming one day into the theatre, the audience, to show their regard, threw, as the custom

30 His death.

then was, their cloaks upon him; and the multitude of these being very great, they stifled the old man, who was too weak to disengage himself from their load.

After the expulsion of Draco, nothing remarkable happened at Athens till the year before Christ 606,

31 Mityleni-an war.

when we find the republic engaged in a war with the Mitylenians about the city Sigæum, situated near the mouth of the river Scamander. The Athenian army was commanded by Phrynon, a person equally remarkable for the comeliness of his person and the generosity of his mind. The Mitylenians were commanded by Pittacus, one of the celebrated sages of Greece. As the commanders looked upon the honour of their respective countries to be concerned, they exerted themselves to the utmost. At last they met in single combat: wherein Phrynon depended on his valour only; but Pittacus concealed behind his shield a net, wherewith he suddenly entangled his antagonist, and easily slew him. This, however, not putting an end to the war, Periander tyrant of Corinth interposed; and both parties having submitted to his arbiration, he decreed that Sigæum should belong to the Athenians.

32 Cylon's conspiracy.

About seven years after this war, a conspiracy was formed by Cylon son-in-law to Theagenes tyrant of Megara, who, having by his affable behaviour procured many friends, formed a design of seizing the sovereignty of Athens. Having consulted the oracle as to the most proper time, he was directed to make the attempt when the citizens of Athens were employed in celebrating the highest feast to Jupiter. When many of the citizens therefore were gone to the Olympic games, Cylon and his associates made themselves masters of the citadel. Here they were instantly besieged by Megacles at that time archon, and soon reduced to great distress for want of water. The chief together with his brother found means to make their escape, but the meaner sort were left to shift for themselves. In this extremity they fled to the temple of Minerva; from whence Megacles with much ado prevailed upon them to come down and submit themselves to the mercy of their country. Having at last assented to this, they tied a cord to the image of the goddess, and carried the clue with them, to demonstrate, that though they were out of the temple they were still under Minerva's

33 Conspirators massacred by Megacles.

protection. Unfortunately for them, however, as they passed the temple of the furies, the line snapt of itself; which Megacles construing into a renunciation by the goddess, caused his men fall upon them and dispatch as many as they could find. Such as were without the temple were immediately massacred, and those who fled thither again were murdered in their sanctuary. In short, none escaped but such as bribed the wives of the officers of justice. This carnage, however, did not put an end to the sedition. The remains of Cylon's faction created great disturbances, by insinuating that the violation of Minerva's sanctuary had drawn down the an-

34 Who is execrated by the people.

ger of the gods; and these discourses had such an effect, that Megacles and his officers were styled *execrable*, and held to be persons under the displeasure of heaven.

During the time of this confusion, the Megarensians attacked Nisea, which they took, as well as Salamis; and so completely routed the Athenians in every attempt to recover the latter, that a law was at last passed by which it should be capital for any one to propose the recovery of Salamis.

35 Unsuccessful war with Megara.

About the same time the city was disturbed by reports of frightful appearances, and filled with superstitious fears; the oracle at Delphi was therefore consulted, and an answer returned that the city behoved to be expiated. Upon this, Epimenides the Phestian was sent for from Crete, to perform the necessary ceremonies, he being reputed an holy man, and one that was deeply skilled in all the mysteries of religion. His expiation consisted in taking some black, and some white sheep, turning them all loose, and directing some persons to follow them to those places where they couched, and there to sacrifice them to the local deity.

36 Epimenides's expiation and prophecy.

He caused also many temples and chapels to be erected, two of which have been particularly noted, viz. the chapel of *Contumely* and that of *Impudence*. This man is said to have looked wistfully on the port of Munychia for a long time, and then to have spoke as follows to those that were near him. "How blind is man to future things? for did the Athenians know what mischief will one day be derived to them from this place, they would eat it with their teeth." This prediction was thought to be accomplished 270 years after, when Antipater constrained the Athenians to admit a Macedonian garrison into that place.

37 Solon the wise legislator.

About 597 years before Christ, Solon the famed Athenian legislator began to show himself to his countrymen. He is said to have been lineally descended from Codrus; but left by his father in circumstances rather necessitous, which obliged him to apply to merchandize; it is plain, however, both from his words and writings, that he was a disinterested patriot. The shameful decree, that none under pain of death should propose the recovery of Salamis, grieved him so much, that having composed an elegy of 100 verses, such as he thought would be most proper to inflame the minds of the people, he ran into the market-place as if he had been mad, with his night-cap on his head, repeating his elegy.

38 Salamis recovered by his means.

A crowd being gathered round the pretended madman, his kinsman Pisistratus mingled among the rest, and observing the people moved with Solon's words, he also seconded him with all the eloquence he was master of, and between them they prevailed so far as to have the law repealed, and a war was immediately commenced against the people of Megara. Who was commander in this expedition is not certain; but the city was recovered, according to the most general account, by the following stratagem. Solon coming with Pisistratus to Colias, and finding there the women busy in celebrating, according to custom, the feast of Ceres, sent a confident of his to Salamis, who pretended to be no friend to the people of Attica, telling the inhabitants of Salamis, that if they had a mind to seize the fairest of the Athenian ladies, they might now do it by passing over to Colias. The Megarensians giving easy credit to what the man said, immediately fitted out a ship; which Solon perceiving from the opposite shore, dismissed the women, and having dressed a number of beardless youths in female habits, under which

Attica. which they concealed every one a dagger, he ſent them to the ſea-ſide to dance and divert themſelves as the women are wont to do. When thoſe who came from Salamis ſaw theſe young perſons ſkipping up and down, they ſtrove who ſhould be firſt on ſhore; but were every one of them killed, and their veſſel ſeized; aboard which the Athenians embarking, ſailed immediately to Salamis and took it.

39 Cirrha likewiſe reduced by Solon's wiſdom. On the return of Solon to Athens, he was greatly honoured by the people, to whom another occaſion of admiring his wiſdom was quickly afforded. The inhabitants of Cirrha, a town ſituated in the bay of Corinth, after having by repeated incurſions waſted the territory of Delphi, at laſt beſieged the capital itſelf, with a view of making themſelves maſters of the treaſures contained in the temple of Apollo. Advice of this intended ſacrilege being ſent to the Amphictyons, who were the ſtates-general of Greece, Solon adviſed that the matter ſhould be univerſally reſented, and that all the ſtates ſhould join in puniſhing the Cirrhæans, and ſaving the Delphic oracle. This advice was complied with, and a general war againſt Cirrha declared. Clyſthenes, tyrant of Sicyon, commanded in chief, and Alcmæon was general of the Athenian quota. Solon went as aſſiſtant or counſellor to Clyſthenes, and by following his advice the war was conducted to a proſperous iſſue. For when the Greek army had beſieged Cirrha for ſome time without any appearance of ſucceſs, the oracle at Delphi was conſulted, from whence the following anſwer was returned:

"In vain you hope to take the place before
"The ſea's blue waves roll o'er the hallow'd ſhore."

This anſwer ſtruck the whole army with ſurpriſe, till Solon adviſed Clyſthenes to conſecrate ſolemnly the whole territory of Cirrha to the Delphic Apollo; ſo as that was a maritime country, the ſea muſt then waſh the ſacred coaſt. According to Pauſanius, the city was reduced by the following ſtratagem, likewiſe invented by Solon. He cauſed the river Pliſtus, which run through Cirrha, to be turned into another channel, hoping thereby to have diſtreſſed the inhabitants for want of water: but finding they had many wells within the city, and were not to be reduced by that means, he cauſed a vaſt quantity of roots of hellebore to be thrown into the river, which was then ſuffered to return into its former bed. The inhabitants, overjoyed at the ſight of running water, came in troops to drink of it; whereupon an epidemic flux enſued, and the citizens being no longer able to defend the walls, the town was eaſily taken.

40 Athens in great confuſion. On the return of Solon to Athens he found things again in the utmoſt confuſion. The remnant of Cylon's faction gave out, that all ſorts of misfortunes had befallen the republic on account of the impiety of Megacles and his followers; which clamour was heightened by the retaking of Salamis about this time by the Megarenſians. Solon interpoſed, and perſuaded thoſe who were ſtyled *execrable* to abide a trial, and 300 perſons were choſen to judge them. The event was, that

41 Megacle's party baniſhed. 300 of Megacle's party who were alive were ſent into perpetual baniſhment, and the bones of ſuch as were dead were dug up and ſent without the limits of their country.

Attica. Though this deciſion reſtored the public quiet for the preſent, it was not long before the people were divided

42 Three factions ſtart up. into three factions, contending about the proper form of government. Theſe were called the *Diacrii*, *Pediæi*, and *Parali*: the firſt of theſe were the inhabitants of the hilly country, who declared poſitively for democracy; the ſecond, dwelling in the lower parts, and who were far more opulent than the former, declared for an oligarchy, as ſuppoſing the government would fall moſtly into their hands; the third party, who lived on the ſea-coaſt, were people of moderate principles, and therefore were for a mixed government. Beſides the diſturbances raiſed on this account, others were occaſioned by the rich oppreſſing the poor. According to Plutarch, the poor being indebted to the rich, either tilled their grounds and paid them the ſixth part of the produce, or engaged their bodies for their debts, ſo that many were made ſlaves at home, and many ſold into other countries; nay, ſome were obliged to ſell their children to pay their debts, and others in deſpair quitted Attica altogether. The greateſt part, however, were for throwing off the yoke, and began to look about for a leader, openly declaring that they intended to change the form of government, and make a repartition of lands. In this extremity, the eyes of all the citizens were caſt upon Solon. The moſt prudent were for offering him the ſovereignty; but he perceiving their intentions, behaved in ſuch a manner as to cheat both parties, and ſhewed a ſpirit of patriotiſm perhaps never equalled. He refuſed the ſovereignty as far as it might have benefited himſelf; and yet took upon himſelf all the care and trouble of a prince, for the ſake of his people.

43 Solon choſen archon. He was choſen archon without having recourſe to lots, and after his election diſappointed the hopes of both parties. It was Solon's fundamental maxim, That thoſe laws will be beſt obſerved which power and juſtice equally ſupport. Wherever, therefore, he found the old conſtitution conſonant to juſtice in any tolerable degree, he refuſed to make any alteration at all, and was at extraordinary pains to ſhow the reaſon of the changes he did make. In ſhort, being a perfect judge of human nature, he ſought to rule only by ſhowing his ſubjects that it was their intereſt to obey, and not by forcing upon them what he himſelf eſteemed beſt. Therefore, to a perſon who aſked whether he had given the Athenians the beſt laws in his power, he replied, "I have eſtabliſhed the beſt they could receive."

44 Settles all diſorders. As to the main cauſe of ſedition, viz. the oppreſſed ſtate of the meaner ſort Solon removed it by a contrivance which he called *ſiſachthia*, i. e. *diſcharge*; but what this was, authors are not agreed upon. Some ſay that he releaſed all debts then in being, and prohibited the taking any man's perſon for payment of a debt for the future. According to others the poor were eaſed, not by cancelling the debts, but by lowering the intereſt, and increaſing the value of money; a mina, which before was made equal to 73 drachms only, being by him made equal to 100; which was of great advantage to the debtor, and did the creditor no hurt. It is, however, moſt probable that the ſiſachthia was a general remittance of all debts whatever, otherwiſe Solon could not have boaſted in his verſes that he

he had removed so many marks of mortgages (B) as were every where frequent; that he had freed from apprehension such as were driven to despair, &c.

45 Infamous behaviour of his three friends.

But in the midst of all Solon's glory, an accident befel him, which, for a time, hurt his reputation, and had almost entirely ruined his schemes. He had consulted Conon, Clinias, and Hipponicus, his three friends, on an oration prepared with a view to engage the people's consent to the discharge; and these three men, thus knowing there was to be a general discharge of debts, basely took the opportunity of borrowing vast sums before the law was promulgated, in consequence of which they were never obliged to return them.

This was thought at first to have been done with Solon's consent, and that he had shared in the money; but this aspersion was quickly wiped off when it appeared that the lawgiver himself was a very considerable loser by his own law. His friends, however, could never recover their credit, but were ever afterwards stigmatized with the opprobrious appellation of *chreocopidæ*, or *debt-sinkers*.

46 Solon blamed at first, but afterwards applauded and chosen legislator.

The Athenians were as little pleased with Solon's management as with their former condition; the rich thinking he had done too much in cancelling the money-debts due to them, and the poor that he had done too little, because he had not divided the lands of Attica equally. In a short time, however, they acquiesced in the new institutions, and gave a more public token of their repentance than they had before shown of their displeasure, instituting a solemn sacrifice under the name of *Sisacthia*, at the same time that Solon was unanimously elected legislator of Athens, with full power to make laws, and alter or new model the constitution as he thought fit.

47 Compiles a new body of laws.

Solon being now invested with unlimited authority, set about the arduous task of compiling new laws for the turbulent people of Attica; which having at last completed in the best manner he was able, or in the best manner the nature of the people would admit, he procured them to be ratified for 100 years. Such as related to private actions were preserved on parallelograms of wood, with cases which reached from the ground, and turned about upon a pin like a wheel. These were thence called *Axones;* and were placed first in the citadel, and afterwards in the prytaneum, that all the subjects might have access to them when they pleased. Such as concerned public institutions and sacrifices were contained in triangular tables of stone called *cyrbes*. The Athenian magistrates were sworn to observe both; and in process of time these monuments of Solon's wisdom became so famous, that all public acts were from them named *Axones* and *Cyrbes*.

48 He goes abroad for ten years.

After the promulgation of the laws, Solon found himself obliged to leave Athens, to prevent his being continually teazed for explanations and alterations of them. He therefore pretended an inclination to merchandize, and obtained leave to absent himself for 10 years, during which time he hoped the laws would be grown familiar. From Athens Solon travelled into Egypt, where he conversed with Psenophis the Heliopolitan, and Sonchis the Saite, the most learned priests of that age. From these he learned the situation of the island Atlantis, of which he wrote an account in verse, which Plato afterwards continued*. From Egypt he went to Cyprus, where he was extremely well received by one of the petty kings. This prince lived in a city called *Apeia*, built by Demophon the son of Theseus, on an eminence near the river Clarius, but in a soil craggy and barren. Solon observing a very pleasant plain below, engaged the king to remove thither; assisted in executing the scheme he had formed; and succeeded so well, that a new city was formed, which soon became populous, and out of gratitude to the Athenian legislator was called *Solos*.

* See *Atlantis*.

49 Things fall into disorder in his absence.

But while Solon was thus travelling in quest of wisdom, and with a view to benefit those among whom he came, his countrymen, who seem to have resolved on being dissatisfied at all events, had again divided themselves into three factions. Lycurgus put himself at the head of the country people; Megacles the son of Alcmæon was at the head of those who lived on the sea-coast; and Pisistratus put himself at the head of the poorer sort, to protect them, as he pretended, from tyranny, but in reality to seize on the sovereignty for himself. All the factions pretended to have a vast regard for Solon and his laws, at the same time that they were very desirous of a change; but how they were to be bettered, none of them knew, or pretended to know.

50 He returns to Athens, but refuses to resume his office.

In the midst of this confusion the legislator returned. Each of the factions paid their court to him, and affected to receive him with the deepest reverence and respect; beseeching him to reassume his authority, and compose the disorders which they themselves kept up. This Solon declined on account of his age, which, he said, rendered him unable to speak and act for the good of his country as formerly: however, he sent for the chiefs of each party, beseeching them in the most pathetic manner not to ruin their common parent, but to prefer the public good to their own private interest.

Pisistratus, who of all the three had perhaps the least intention to follow Solon's advice, seemed to be the most affected with his discourses; but as Solon perceived he affected popularity by all possible methods, he easily penetrated into his designs of assuming the sovereign power. This he spoke of to Pisistratus himself, at first privately; but as he saw that his admonitions in this way had no effect, he then said the same things to others, that the public might be on their guard against him.

51 Pisistratus assumes the sovereignty

All the wise discourses of Solon, however, were lost upon the Athenians. Pisistratus had got the meaner sort entirely at his devotion, and therefore resolved to cheat them out of the liberty which they certainly deserved to lose. With this view he wounded himself, and, as Herodotus says, the mules that drew his chariot; then he drove into the market-place, and there showed his bleeding body, imploring the protection of the people from those whom his kindness to them had ren-

(B) The Athenians had a custom of hanging up billets to show that houses were engaged for such and such sums of money.

rendered his implacable enemies. A concourſe of people being inſtantly formed, Solon came among the reſt, and, ſuſpecting the deceit, openly taxed Piſiſtratus with his perfidious conduct; but to no purpoſe. A general aſſembly of the people was called, wherein it was moved by one Ariſton, that Piſiſtratus ſhould have a guard. Solon was the only perſon preſent who had reſolution enough to oppoſe this meaſure; the richer Athenians, perceiving that the multitude implicitly followed Piſiſtratus, and applauded every thing he ſaid, remaining ſilent through fear. Solon himſelf, when he ſaw he could prevail nothing, left the aſſembly, ſaying he was *wiſer* than ſome, and *ſtouter* than others. A guard of 400 men was now unanimouſly decreed to Piſiſtratus, as we are told by Solon himſelf. This inconſiderable body he made uſe of to enſlave the people, but in what manner he accompliſhed his purpoſe is not agreed. Certain it is, that with his guard he ſeized the citadel; but Polyænus hath given an account of a very ſingular method which he took to put it out of the power of the Athenians to defend themſelves even againſt ſuch a ſmall number. He ſummoned an aſſembly to be held at the Anacium, and directed that the people ſhould come thither armed. They accordingly came; and Piſiſtratus harangued them, but in a voice ſo low that they could not tell what he ſaid. The people complaining of this, Piſiſtratus told them that they were hindered from hearing him by the clangour of their arms; but if they would lay them down in the portico, he would then be heard diſtinctly. This they did; and while they liſtened very attentively to a long and eloquent oration, Piſiſtratus's guard conveyed away their arms, ſo that they found themſelves deprived of all power of reſiſtance.

52 Solon leaves Athens.

During the confuſion which followed this event, another aſſembly was held, wherein Solon enveighed bitterly againſt the meanneſs of his countrymen, inviting them to take up arms in defence of their liberty. When he ſaw that nothing would do, he laid down his own arms, ſaying, that he had done his utmoſt for his country and his laws. According to Plutarch, he refuſed to quit the city; but the moſt probable opinion is, that he immediately retired from the dominions of Athens, and refuſed to return, even at the ſolicitation of Piſiſtratus himſelf.

53 Piſiſtratus governs with great moderation

Piſiſtratus having thus obtained the ſovereignty, did not overturn the laws of Solon, but uſed his power with the greateſt moderation. It is not to be expected, however, that ſo turbulent a people as the Athenians could be ſatisfied by any method of government he could lay down. At the beginning of his adminiſtration, Megacles and his family retired out of Athens to ſave their own lives, yet without deſpairing of being able ſome time or other to return. With this view Megacles and his aſſociates entered into a treaty with Lycurgus; and having brought him and his party into a ſcheme for depoſing Piſiſtratus, they concerted matters ſo well, that Piſiſtratus was ſoon obliged to ſeek for ſhelter ſomewhere elſe, and, on his departure, the Athenians ordered his goods to be ſold. Nobody, however, except one perſon *(Callias)*, would venture to buy any of them, from an apprehenſion, no doubt, that they would ſoon be reſtored to their proper owner, which accordingly happened in a very ſhort time.

54 Driven out by Megacles.

As Megacles and his party had negociated with Lycurgus to turn out Piſiſtratus, ſo they now entered into a treaty with Piſiſtratus to reinſtate him in his principality, as ſoon as they found Lycurgus would not be implicitly governed by them.

55 Who ſoon after reinſtates him.

To accompliſh this, they fell upon a very ridiculous project; which, however, was attended with the deſired ſucceſs. They found out a woman whoſe name was *Phya*, of a mean family and fortune, but of a great ſtature, and very handſome. Her they dreſſed in armour, placed her in a chariot, and having diſpoſed things ſo as to make her appear with all poſſible advantage, they conducted her towards the city, ſending heralds before, with orders to ſpeak to the people in the following terms: "Give a kind reception, O Athenians, to Piſiſtratus, who is ſo much honoured by Minerva above all other men, that ſhe herſelf condeſcends to bring him back to the citadel." The report being univerſally ſpread that Minerva was bringing home Piſiſtratus, and the ignorant multitude believing this woman to be the goddeſs, addreſſed their prayers to her, and received Piſiſtratus with the utmoſt joy. When he had recovered the ſovereignty, Piſiſtratus married the daughter of Megacles as he had promiſed, and gave the pretended goddeſs to his ſon Hipparchus.

56 Driven out a ſecond time.

Piſiſtratus did not long enjoy the kingdom to which he had been reſtored in ſo ſtrange a manner. He had married the daughter of Megacles, as already obſerved; but having children by a former wife, and remembering that the whole family of Megacles was reprobated by the Athenians, he thought proper to let his new ſpouſe remain in a ſtate of perpetual widowhood. This ſhe patiently bore for ſome time, but at laſt acquainted her mother. An affront ſo grievous could not fail to be highly reſented. Megacles inſtantly entered into a treaty with the malcontents, of whom there were always great plenty at Athens whatever was the form of government. This Piſiſtratus being apprized of, and perceiving a new ſtorm gathering, he voluntarily quitted Athens, and retired to Eretria. Here having conſulted with his ſons, it was reſolved to reduce Athens by force. With this view he applied to ſeveral of the Greek ſtates, who furniſhed him with the troops he deſired, but the Thebans exceeded all the reſt in their liberality; and with this army he returned to Attica,

57 But returns with an army.

according to Herodotus, in the 11th year of his baniſhment. They firſt reduced Marathon, the inhabitants of which had taken no meaſures for their defence, tho' they knew that Piſiſtratus was preparing to attack them. The republican forces in the mean time marched out of Athens to attack him; but behaving in a ſecure and careleſs manner, they were ſupriſed by Piſiſtratus, and totally routed. While they were endeavouring to make their eſcape, he cauſed his two ſons ride before him with all ſpeed, and tell thoſe they came up with that nobody had any thing to fear, but that they might every one return to his own home. This ſtratagem ſo effectually diſperſed the republican army, that it was impoſſible to rally them, and Piſiſtratus became a third time abſolute maſter of Attica.

58 He takes poſſeſſion of the city.

59 His ſubjects ſtill diſcontented notwithſtanding his moderation.

Piſiſtratus being once more in poſſeſſion of the ſovereignty, took a method of eſtabliſhing himſelf on the throne directly oppoſite to what Theſeus had done. Inſtead of collecting the inhabitants from the country into cities, Piſiſtratus made them retire from the cities into the country, in order to apply themſelves

 ſelves to agriculture. This prevented their meeting together, and caballing againſt him in ſuch bodies as they had been accuſtomed to do. By this means alſo the territory of Athens was greatly meliorated, and great plantations of olives were made over all Attica, which had before not only been deſtitute of corn, but alſo bare of trees. He alſo commanded, that, in the city men ſhould wear a kind of ſheep-ſkin veſt, reaching to the knees; but ſo intolerable were the laws of Piſiſtratus to his ſubjects, that this kind of garment in ſucceeding times became proverbially the habit of ſlavery.

As prince of Athens, Piſiſtratus received the tenth part of every man's revenues, and even of the fruits of the earth; and this alſo, though for the ſervice of the ſtate, ſeemed to the Athenians a moſt grievous burden. In ſhort, though Piſiſtratus behaved in all reſpects as a moſt excellent prince, his ſubjects fancied themſelves oppreſſed by tyranny, and were perpetually grumbling from the time he firſt aſcended the throne to the day of his death, which happened about 33 years after he had firſt aſſumed the ſovereignty, of which time, according to Ariſtotle, he reigned 17 years.

60
Hipparchus and Hippias.

Piſiſtratus left behind him two ſons named *Hipparchus* and *Hippias*, both men of great abilities, who ſhared the government between them, and behaved with lenity and moderation. But though by the mildneſs of their government the family of the Piſiſtratidæ ſeemed to be fully eſtabliſhed on the throne of Athens, a conſpiracy was unexpectedly formed againſt both the brothers, by which Hipparchus was taken off, and Hippias narrowly eſcaped. The moſt material facts relating to this conſpiracy are what follow.

61
Conſpiracy of Harmodius and Ariſtogiton.

There were at that time in Athens two young men called *Harmodius* and *Ariſtogiton*; the former of theſe was exquiſitely beautiful in his perſon, and on that account, according to the infamous cuſtom of the Greeks, violently beloved of the other. This Harmodius was alſo beloved of Hipparchus; who, if we may believe Thucydides, forced him. This was grievouſly reſented, and revenge determined on; to haſten which, another accident concurred. Hipparchus finding that Harmodius endeavoured to avoid him, publicly affronted him, by not ſuffering his ſiſter to carry the offering of Minerva, as if ſhe was a perſon unworthy of that office. The two young men, not daring to ſhow any public ſigns of reſentment, conſulted privately with their friends; among whom it was reſolved, that at the approaching feſtival of Panathenæa, when the citizens were allowed to appear in arms, they ſhould attempt to reſtore Athens to its former liberty. In this they imagined that they ſhould find themſelves ſeconded by the whole body of the people. But when the day appointed was come, they perceived one of their number talking very familiarly with Hippias; and fearing that they were diſcovered, they immediately fell upon Hipparchus, and diſpatched him with a multitude of wounds.

62
Hipparchus killed.

In this exploit the people were ſo far from ſeconding them, as they expected, that they ſuffered Harmodius to be killed by Hipparchus's guards, and ſeizing Ariſtogiton themſelves, delivered him up to Hippias. Some time afterwards, however, the reſpect they paid to theſe two young men exceeded all bounds. They cauſed their praiſes to be ſung at the Panathenæa, forbid any citizen to call a ſlave by either of their names, and erected brazen ſtatues to them in the forum; which ſtatues were afterwards carried into Perſia by Xerxes, and ſent back from thence by Alexander the Great, Antiochus, or Seleucus, for authors are not agreed by which. Several immunities and privileges were alſo granted to the deſcendants of theſe two patriots, and all poſſible means were taken to render their memory venerable and reſpected by poſterity.

63
The conſpirators extravagantly honoured.

64
Cruelty of Hippias.

Hippias being now ſole maſter of Athens, and probably exaſperated by the murder of his brother, began to alter his conduct greatly, and treat his ſubjects in an oppreſſive and cruel manner. He began with torturing Ariſtogiton, in order to make him confeſs his accomplices: but this proved fatal to his own friends; for Ariſtogiton impeaching ſuch as he knew to be beſt affected to Hippias, they were immediately put to death; and when he had deſtroyed all thoſe he knew, at laſt told Hippias, that now he knew of none that deſerved to ſuffer death except the tyrant himſelf. Hippias now vented his rage on a woman named *Leæna*, who was kept by Ariſtogiton. She endured the torture as long as ſhe could; but finding herſelf unable to bear it any longer, ſhe at laſt bit off her tongue, that ſhe might not have it in her power to make any diſcovery. To her the Athenians erected the ſtatue of a lioneſs, alluding to her name, without a tongue, on which was engraved a ſuitable inſcription.

After the conſpiracy was, as Hippias thought, thoroughly quaſhed, he ſet himſelf about ſtrengthening his government by all the means he could think of. He contracted leagues with foreign princes, increaſed his revenues by various methods, &c. But theſe precautions were of little avail: the lenity of Piſiſtratus's government had alone ſupported it; and Hippias purſuing contrary methods, was deprived of the ſovereignty in leſs than four years after the death of his brother.

65
He is driven out of Athens.

This revolution was likewiſe owing to the family of Megacles, who were ſtyled *Alcmæonidæ*, and had ſettled at Lipſydrum. In times of diſcontent, which at Athens were very frequent, this family was the common refuge of all who fled from that city; and at laſt they thought of a method of expelling the Piſiſtratidæ altogether. The method they took to accompliſh their purpoſe was as follow. They agreed with the Amphictyons to rebuild the temple at Delphi; and being poſſeſſed of immenſe riches, they performed their engagements in a much more magnificent manner than they were bound to do; for having agreed only to build the front of common ſtone, they built it of Parian marble. At the ſame time they corrupted the propheteſs Pythia, engaging her to exhort all the Lacedemonians that came to conſult the oracle either in behalf of the ſtate, or their own private affairs, to attempt the delivery of Athens. This had the deſired effect: The Lacedemonians ſupriſed at hearing this admonition inceſſantly repeated, at laſt reſolved to obey the divine command, as they imagined it to be; and ſent Anchimolius, a man of great quality, at the head of an army into Attica, though they were at that time in league with Hippias, and accounted by him his good friends and allies. Hippias demanding aſſiſtance from the Theſſalians, they readily ſent him 1000 horſe,

 under

under the command of one of their princes named *Cineas*. The Lacedemonians being landed, Hippias fell upon them so suddenly, that he defeated them with geat slaughter, killed their general, and forced the shattered remains of their army to fly to their ships. The Spartans, incensed at this unfortunate expedition, determined to send another army into Attica; which they accordingly did soon after under their king Cleomenes: and he having, at his entrance into the Athenian territories, defeated the Thessalian horse, obliged Hippias to shut himself up in the city of Athens, which he was soon after forced to abandon altogether. He was, however, in no want of a place of refuge; the Thessalian princes inviting him into their country, and the king of Macedon offering his family a city and territory, if they chose to retire into his dominions.

66 And retires to Sigeum.

But Hippias chose rather to go to the city of Sigeum, which Pisistratus had conquered, and left to his own family.

After the expulsion of the Pisistratidæ, the Athenians did not long enjoy the quiet they had proposed to themselves.

67 Two factions in Athens.

They were quickly divided into two factions; at the head of one was Clysthenes, one of the chiefs of the Alcmæonidæ; and the other, Isagoras, a man of great quality, and highly in favour with the Athenian nobility. Clysthenes applied himself to the people, and endeavoured to gain their affections by increasing their power as much as possible. Isagoras perceiving that by this means his rival would get the better, applied to the Lacedemonians for assistance, reviving at the same time the old story of Megacles's sacrilege, and insisting that Clysthenes ought to be banished as being of the family of Megacles.

68 The Spartans support Isagoras.

Cleomenes king of Sparta readily came into his measures, and suddenly dispatched an herald to Athens with a declaration of war in case all the Alcmæonidæ were not immediately banished. The Athenians did not hesitate to banish their benefactor Clysthenes, and all his relations; but this piece of ingratitude did not answer their purpose. Cleomenes entered Attica at the head of a Spartan army; and, arriving at Athens, condemned to banishment 700 families more than what had been sent into exile before. Not content with this, he would have dissolved the senate, and vested the government in 300 of the chief of Isagoras's faction. This the Athenians would by no means submit to; and therefore took up arms, and drove Cleomenes and his troops into the citadel, where they were besieged for two days. On the third day Cleomenes surrendered, on condition that all those who were in the citadel should retire unmolested. This, though agreed to, was not performed by the Athenians. They fell upon such as were separated from the army, and put them to death without mercy. Among the number of those slain on this occasion was Timesitheus the brother of Cleomenes himself.

69 But without success.

The Spartan king was no sooner withdrawn from Athens, than he formed a strong combination in favour of Isagoras. He engaged the Bœotians to attack Attica on the one side, and the Chalcidians on the other, while he at the head of a powerful Spartan army entered the territories of Eleusina. In this distress, the Athenians, not being able to cope with so many enemies at once, resolved to suffer their territories to be ravaged by the Chalcidians and Bœotians, contenting themselves with opposing the army commanded by Cleomenes in person. But this powerful confederacy was quickly dissolved: the Corinthians, who were allied with Cleomenes, doubting the justice of their cause, returned home; his other allies likewise beginning to waver, and his colleague Ariston, the other king of Sparta, differing in sentiments, Cleomenes was obliged to abandon the enterprise. The Spartans and their allies being withdrawn, the Athenians took a severe revenge of the Bœotians and Chalcidians, totally routing their forces, and carrying off a great number of prisoners. 70

Bœotians and Chalcidians defeated.

The prisoners taken in this war were put in irons, but afterwards set at liberty on paying a ransom of two minæ per head. Their fetters were, however, hung up in the citadel; and the Athenians consecrated the tenth of what they had received for ransom, purchased a statue, representing a chariot and four horses, which they set up in the portico of the citadel, with a triumphant inscription in token of their victory.

These indignities rousing the Bœotians, they immediately vowed revenge, and engaged on their side the people of Ægina, who had an hereditary hatred at the Athenians; and while the latter bent all their attention to the Bœotian war, the Ægenitans landing a considerable army, ravaged the coasts of Attica. 71

Attempt of the Spartans to restore Hippias.

But while the Athenians were thus employed against the Bœotians and Æginetans, a jealousy sprung up on the part of Lacedæmon, which was never afterwards eradicated. Cleomenes, after his unsuccessful expedition against Attica, produced at Sparta certain oracles which he said he had found in the citadel of Athens while he was besieged therein: the purport of these oracles was, that Athens would in time become a rival to Sparta. At the same time it was discovered, that Clysthenes had bribed the priestess of Apollo to cause the Lacedæmonians expel the Pisistratidæ from Athens; which was sacrificing their best friends to those whom interest obliged to be their enemies. This had such an effect, that the Spartans, repenting their folly in expelling Hippias, sent for him from Sigeum, in order to restore him to his principality: but this not being agreed to by the rest of the states, they were forced to abandon the enterprise, and Hippias returned to Sigeum as he came. 72

Cause of the war with Persia.

About this time too, Aristagoras the Milesian having set on foot a revolt in Ionia against the Persian king, applied to the Spartans for assistance; but they declining to have any hand in the matter, he next applied to the Athenians, and was by them furnished with 20 ships under the command of Melanthus, a nobleman universally esteemed. This rash action cost the Greeks very dear, as it brought upon them the whole power of the Persian empire; for no sooner did the king of Persia hear of the assistance sent from Athens to his rebellious subjects, than he declared himself the sworn enemy of that city, and solemnly besought God that he might one day have it in his power to be revenged on them.

The Ionian war being ended, by the reduction of that country again under the Persian government, the king of Persia sent to demand earth and water as tokens of submission from the Greeks. Most of the islanders yielded to this command out of fear, and among the rest the people of Ægina; upon which the Athenians accused

Attica.

accused the inhabitants of this island of treachery towards Greece, and a war was carried on with them for a long time. How it ended we are not informed; but its continuance was fortunate for Greece in general, as, by inuring them to war, and sea-affairs in particular, it prevented the whole of the Grecian states from being swallowed up by the Persians who were now about to invade them.

Besides the displeasure which Darius had conceived against the Athenians on account of the assistance they had afforded the Ionians, he was further engaged to an expedition against Greece by the intrigues of Hippias.

73 Hippias applies to the Persians.

Immediately on his returning unsuccessfully from Lacedemon, as above related, Hippias passed over into Asia, went to Artaphernes governor of the adjacent provinces belonging to the Persian king, and excited him to make war upon his country, promising to be obedient to the Persian monarch provided he was restored to the principality of Athens. Of this the Athenians being apprized, sent ambassadors to Artaphernes, desiring leave to enjoy their liberty in quiet: but that nobleman returned for answer, that if they would have peace with the great king, they must immediately receive Hippias; upon which answer the Athenians resolved to assist the enemies of Darius as much as possible. The consequence of this resolution was, that Darius commissioned Mardonius to revenge him of the insults he thought the Greeks had offered him. But Mardonius having met with a storm at sea, and other accidents, which rendered him unable to do any thing, Datis and Artaphernes the son of Artaphernes abovementioned, were commissioned to do what he was to have done.

74 They invade Greece.

The Persian commanders, fearing again to attempt to double the promontory of Athos, where their fleet had formerly suffered, drew their forces into the plains of Celicia; and passing from thence through the Cyclades to Euboea, directed their course to Athens. Their charge from Darius was to destroy both Eretria and Athens; and to bring away the inhabitants, that they might be at his disposal. Their first attempt was

75 Eretria destroyed.

on Eretria, the inhabitants of which sent to Athens for assistance on the first approach of the Persian fleet. The Athenians, with a magnanimity almost unparalleled at such a juncture, sent 4000 men to their assistance; but the Eretrians were so much divided among themselves, that nothing could be resolved on. One party among them was for receiving the Athenian succours into the city; another, for abandoning the city and retiring into the mountains of Euboea; while a third sought to betray their country to the Persians for their own private interest. Seeing things in this situation, therefore, and that no good could possibly be done, one Æschines, a man of great authority among the Eretrians, generously informed the Athenians commanders that they might return home. They accordingly retired to Oropus, by which means they escaped destruction: for Eretria being soon after betrayed to the Persians, was pillaged, burnt, and its inhabitants sold for slaves.

On the news of this disaster the Athenians immediately drew together all the forces they were able, which after all amounted to no more than 9000 men. These, with 1000 Platæans who afterwards joined them, were commanded by ten general officers, who had equal power; among whom were Miltiades, Aristides, and Themistocles, men of distinguished valour and great abilities. But it being generally imagined that so small a body of troops would be unable to resist the formidable power of the Persians, a messenger was dispatched to Sparta to intreat the immediate assistance of that state. He communicated his business to the senate in the following terms: "Men of Lacedæmon, the Athenians desire you to assist them, and not to suffer the most ancient of all the Grecian cities to be enslaved by the barbarians. Eretria is already destroyed, and Greece consequently weakened by the loss of so considerable a place." The assistance was readily granted; but at the same time the succours arrived so slowly, that the Athenians were forced to fight without them. In this memorable engagement in the plans of Marathon, whither Hippias had conducted the Persians, the latter were defeated with the loss of 6300 men, while the Greeks lost only 192. The Persians being thus driven to their ships, endeavoured to double Cape Sunium, in order to surprize Athens itself before the army could return: but in this they were prevented by Miltiades; who leaving Aristides with 1000 men to guard the prisoners, returned so expeditiously with the other 9000, that he was at the temple of Hercules, which was but a small way distant, before the barbarians could attack the city.

76 Persians defeated at Marathon.

After the battle, Aristides discharged the trust reposed in him with the greatest integrity. Though there was much gold and silver in the Persian camp, and the tents and ships they had taken were filled with all sorts of riches, he not only forbore touching any thing himself, but to the utmost of his power prevented others from doing it. Some, however, found means to enrich themselves; among the rest, one Callias, cousin-german to Aristides himself. This man being a torch-bearer, and, in virtue of his office, having a fillet on his head, one of the Persians took him for a king, and, falling down at his feet, discovered to him a vast quantity of gold hid in a well. Callias not only seized, and applied it to his own use, but had the cruelty to kill the poor man who discovered it to him, that he might not mention it to others; by which infamous action he entailed on his posterity the name of *Laccopluti*, or *enriched by the well*.

77 Integrity of Aristides.

After the battle of Marathon, all the inhabitants of Platæa were declared free citizens of Athens, and Miltiades, Themistocles, and Aristides, were treated with all possible marks of gratitude and respect. This, however, was but very short-lived; Miltiades proposed an expedition against the island of Paros, in which having been unsuccessful, through what cause is not well known, he was, on his return, accused, and condemned to pay 50 talents, the whole expence of the scheme; and being unable to pay the debt was thrown into prison, where he soon died of a wound received at Paros.

78 Miltiades ungratefully treated by the Athenians.

If any thing can exceed the enormity of such a proceeding as this, it was the treatment Aristides next received. Miltiades had proposed an expedition which had not proved successful, and in which he might possibly have had bad designs; but against Aristides not so much as a shadow of guilt was pretended. On the contrary, his extraordinary virtue had procured him the title of *Just*, and he had never been found to swerve from

79 As likewise Aristides.

from the maxims of equity. His downfal was occaſioned by the intrigues of Themiſtocles: who being a man of great abilities, and hating Ariſtides on account of the character he deſervedly bore among his countrymen, took all opportunities of inſinuating that his rival had in fact made himſelf maſter of Athens without the parade of guards and royalty. "He gives laws to the people (ſaid he); and what conſtitutes a tyrant, but giving laws?" In conſequence of this ſtrange argument, a ſtrong party was formed againſt the virtuous Ariſtides, and it was reſolved to baniſh him for 10 years by the oſtraciſm. In this caſe, the name of the perſon to be baniſhed was written upon a ſhell by every one who deſired his exile, and carried to a certain place within the forum incloſed with rails. If the number of ſhells ſo collected exceeded 6000, the ſentence was inflicted; if not, it was otherwiſe. When the agents of Themiſtocles had ſufficiently accompliſhed their purpoſe, on a ſudden the people flocked to the forum deſiring the oſtraciſm. One of the clowns who had come from a borough in the country, bringing a ſhell to Ariſtides, ſaid to him, "Write me Ariſtides upon this." Ariſtides, ſurpriſed, aſked him if he knew any ill of that Athenian, or if he had ever done him any hurt? "Me hurt! (ſaid the fellow), no, I don't ſo much as know him; but I am weary and ſick at heart on hearing him every where called *the juſt*." Ariſtides therefore took the ſhell, and wrote his own name upon it; and when informed that the oſtraciſm fell upon him, modeſtly retired out of the forum, ſaying, "I beſeech the gods that the Athenians may never ſee that day which ſhall force them to remember Ariſtides."

After the battle of Marathon, the war with Ægina was revived with great vigour; but the Æginetans

80 Themiſtocles adviſes the building of a fleet.

generally had the ſuperiority, on account of their great naval power. Themiſtocles obſerving this, was continually exhorting his countrymen to build a fleet, not only to make them an equal match for the Æginetans, but alſo becauſe he was of opinion that the Perſians would ſoon pay them another viſit. At laſt, he had the boldneſs to propoſe, that the money produced by the ſilver mines, which the Athenians had hitherto divided among themſelves, ſhould be applied to the building of a fleet: which propoſal being complied with, 100 galleys were immediately put upon the ſtocks; and this ſudden increaſe of the maritime power proved the means of ſaving all Greece from ſlavery.

81 Xerxes invades Greece.

About three years after the baniſhment of Ariſtides, Xerxes king of Perſia ſent to demand earth and water: but Themiſtocles deſiring to make the breach with that monarch ſtill wider, put to death the interpreter for publiſhing the decree of the king of Perſia in the language of the Greeks; and having prevailed upon the ſeveral ſtates to lay aſide their animoſities, and provide for their common ſafety, got himſelf elected general of the Athenian army.

When the news arrived that the Perſians were advancing to invade Greece by the ſtraits of Thermopylæ, and that they were for this purpoſe tranſporting their forces by ſea, Themiſtocles adviſed his countrymen to quit the city, embark on board their galleys, and meet their enemies while yet at a diſtance. This they would by no means comply with; for which reaſon Themiſtocles put himſelf at the head of the army, and having joined the Lacedemonians, marched towards Tempe. Here, having received advice that the ſtraits of Thermopylæ were forced, and that both Bœotia and Theſſaly had ſubmitted to the Perſians, the army returned without doing any thing.

In this diſtreſs the Athenians applied to the oracle at Delphi: from whence they received at firſt a very ſevere anſwer, threatening them with total deſtruction; but after much humiliation, a more favourable one was delivered, in which, probably by the direction of Themiſtocles, they were promiſed ſafety in *walls of wood*. This was by Themiſtocles and the greateſt part of the citizens interpreted as a command to abandon Athens, and put all their hopes of ſafety in their fleet. Upon 82

82 Athens abandoned by its inhabitants.

this, the opinion of Themiſtocles prevailing, the greateſt part began to prepare for this embarkation; and had money diſtributed among them by the council of the Areopagus, to the amount of eight drachms per man; but this not proving ſufficient, Themiſtocles gave out that ſomebody had ſtolen the ſhield of Minerva; under pretence of ſearching for which, he ſeized on all the money he could find. Some, however, there were who refuſed to embark with the reſt, but raiſed to themſelves fortifications of wood; underſtanding the oracle in its literal ſenſe, and reſolving to wait the arrival of the Perſians, and defend themſelves to the laſt. In the mean time Ariſtides was recalled, when the Athenians ſaw it their intereſt, leſt he ſhould have gone over to the Perſians and aſſiſted them with his advice. 83

83 And deſtroyed by the Perſians.

The Perſians having advanced to Athens ſoon after the inhabitants had deſerted it, met with no oppoſition except from the few juſt now mentioned; who, as they would hearken to no terms of accommodation, were all cut in pieces, and the city utterly deſtroyed. Xerxes,

84 They are totally defeated at Salamis.

however, being defeated in a ſea-fight at Salamis, was forced to fly with prodigious loſs. See Salamis. Themiſtocles was for purſuing him, and breaking down the bridge he had caſt over the Helleſpont; but this advice being rejected, he ſent a truſty meſſenger to Xerxes, acquainting him that the Greeks intended to break down his bridge, and therefore deſired him to make all the haſte he could, leſt by that means he ſhould be ſhut up in Europe. According to Herodotus, he a ſo adviſed the Athenians to quit the purſuit and return home, in order to build their ruined houſes. This advice, though miſinterpreted by ſome, was certainly a very prudent one, as Xerxes, though once defeated, was ſtill at the head of an army capable of deſtroying all Greece; and had he been driven to deſpair by finding himſelf ſhut up, or warmly purſued, it was impoſſible to ſay what might have been the event. After this, Themiſtocles formed a ſcheme, for the aggrandiſement of Athens indeed, but a moſt unjuſt and infamous one. It was, in ſhort, to make Athens miſtreſs of the ſea by burning all the ſhips except thoſe belonging to that republic. He told his countrymen that he had ſomething to propoſe of great conſequence, but which could not be ſpoken publicly: whereupon he was deſired to communicate it to Ariſtides, by whom the propoſal was rejected; and Ariſtides having informed the Athenians that what Themiſtocles had ſaid was very advantageous but very unjuſt, they deſired him to think no more of it. 85

85 Themiſtocles honoured by the Lacedemonians.

When the fleet returned to Salamis, extraordinary honours were paid to Themiſtocles by the Lacedemonians. On his entering that city, they decreed him a wreath

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wreath of olive as the prize of prudence; preſented him with the moſt magnificent chariot in Sparta; and when he returned to Athens, he was eſcorted by 500 horſe, an honour never paid to any ſtranger but himſelf. On his arrival at Athens, however, there were not wanting ſome who inſinuated that the receiving ſuch honours from the Lacedemonians was injurious to the republic; but Themiſtocles confiding in his innocence, treated theſe clamours with contempt, and exhorted his countrymen to entertain no doubts of their allies, but rather endeavour to preſerve the great reputation they had acquired throughout all Greece.

The defeat of Xerxes at Salamis made Mardonius, who was left to carry on the war by land, more ready to treat with the Athenians than to fight them; and with this view he ſent Alexander king of Macedon to Athens to make propoſals of alliance with that republic, excluſively of all the other Grecian ſtates. This proposal, however, was rejected; and the conſequence was, that Athens was a ſecond time deſtroyed, the Spartans ſending aſſiſtance ſo ſlowly, that the Athenians were forced to retire to Salamis: but they were ſoon freed from all apprehenſions by the total defeat and death of Mardonius at Platæa; where Ariſtides, and the body of troops under his command, diſtinguiſhed themſelves in a moſt extraordinary manner.

86 Athens a ſecond time deſtroyed.

87 The Perſians defeated at Platæa and Mycale.

The ſame day that the battle of Platæa was fought, the Perſians were defeated in a ſea-fight at Mycale in Ionia, wherein it was allowed that the Athenians who were there behaved better than any of the other Greeks; but when it was propoſed to tranſport the Ionians into Europe, that they might be in perfect ſafety, and give them the territories of ſuch Grecian ſtates as had ſided with the Perſians, the Athenians refuſed to comply, fearing the Ionians would rival them in trade, or refuſe the obedience they uſed to pay them: beſides which, they would then loſe the opportunity of plundering the Perſians in caſe of any quarrel with Ionia. Before they returned home, however, the Athenians croſſed over to the Cherſoneſus, and beſieged Seſtos. The ſiege was long and troubleſome: but at laſt the garriſon, being preſſed with hunger, and having no hopes of relief, divided themſelves into two bodies, and endeavoured to make their eſcape; but were purſued, and all either killed or taken. *Oibazus*, one of their commanders, was ſacrificed to a Thracian god; and the other, called *Artyactes*, impaled alive, and his ſon ſtoned before his face, becauſe he had rifled the ſepulchre of Proteſilaus.

88 Seſtos taken by the Athenians.

89 They rebuild their city.

After the victories at Platæa and Mycale, the Athenians returned without any apprehenſion, and began to rebuild their city in a more magnificent manner than before. Here they were no ſooner arrived than a diſpute was ready to be commenced about the form of government. The commons, with Themiſtocles at their head, were for a democracy; to which Ariſtides, rather than hazard the raiſing diſturbances, conſented. It was therefore propoſed, that every citizen ſhould have an equal right to the government; and that the archons ſhould be choſen out of the body of the people, without preference or diſtinction: and this propoſal being agreed to, put an end to all diſcontents for the preſent.

At this time alſo Themiſtocles propoſed that the city of Athens ſhould be fortified in the beſt manner poſſible, that it might not be liable to be again deſtroyed, when the Perſians ſhould take it into their heads to invade Greece. At this propoſal the Lacedemonians were exceedingly alarmed; and therefore remonſtrated, that ſhould Athens once be ſtrongly fortified, and the Perſians become poſſeſſed of it, it would be impoſſible to get them out of it again. At laſt, ſeeing theſe arguments had no effect, they abſolutely forbid the Athenians to carry their walls any higher. This command gave great offence; but Themiſtocles, conſidering the power of Sparta at that time, adviſed the Athenians to temporize; and to aſſure the ambaſſadors, that they ſhould proceed no farther in their work, till by an embaſſy of their own, ſatisfaction ſhould be given to their allies. Being named ambaſſador at his own deſire to Sparta, with ſome other Athenians, Themiſtocles ſet out alone, telling the ſenate that it would be for the intereſt of the ſtate to delay ſending the other ambaſſadors as long as poſſible. When arrived at Sparta, he put off from time to time receiving an audience, on account of his colleagues not being arrived: but in the mean time the walls of Athens were building with the utmoſt expedition; neither houſes nor ſepulchres being ſpared for materials; and men, women, children, ſtrangers, citizens and ſervants, working without intermiſſion. Of this the Lacedemonians having notice, and the reſt of the Athenian ambaſſadors being arrived, Themiſtocles and his colleagues being ſummoned before the ephori, who immediately began to exclaim againſt the Athenians for their breach of promiſe. Themiſtocles denied the charge: he ſaid his colleagues aſſured him of the contrary: that it did not become a great ſtate to give heed to vague reports, but that deputies ought to be ſent from Sparta to inquire into the truth of the matter, and that he himſelf would remain as a hoſtage, to be anſwerable for the event. This being agreed to, he engaged his aſſociates to adviſe the Athenians to commit the Spartan ambaſſadors to ſafe cuſtody till he ſhould be releaſed; after which he publicly avowed the whole tranſaction, took the ſcheme upon himſelf, and told the Lacedemonians that "all things are lawful for our country." The Spartans ſeeing no remedy, concealed their reſentment, and ſent Themiſtocles home in ſafety.

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90 Themiſtocles adviſes to fortify Athens, and deceives the Spartans who oppoſe it.

The next year, being the laſt of the 75th Olympiad, Themiſtocles obſerving the inconvenience of the port Phalerum, thought of making the *Pyræum* the port of Athens. This he did not at firſt think proper to mention publicly; but having ſignified to the people that he had ſomething of importance to communicate, they appointed Xantippus and Ariſtides to judge of his propoſal. They readily came into his meaſures, and told the people that what Themiſtocles propoſed would be of the utmoſt advantage to the ſtate, at the ſame time that it might be performed with eaſe. Upon this they were deſired to lay the matter before the ſenate; who coming unanimouſly into their meaſure, ambaſſadors were diſpatched to Sparta to inſinuate there how proper it would be for the Greeks to have ſome great port, where a fleet might always watch the deſigns of the Perſians; and thus having prevented any umbrage from their firſt undertakings, the work was ſet about with ſuch expedition, that it was finiſhed before the Lacedemonians knew well what they were about.

91 Makes the Pyræum the port of Athens.

At this time alſo the ſovereignty of the ſea was tranſ-

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92 Sovereignty of the ſea transferred to Athens.

transferred from Sparta to Athens, through the haughty behaviour of Pauſanius the Lacedemonian. He had commanded at Platæa, and ſtill enjoyed the ſupreme authority in the war which was all this time carrying on againſt the Perſians; but being elated with his ſucceſs at Platæa, and having entered into a treaſonable correſpondence with the enemy, he treated the captains under his command with the greateſt haughtineſs, giving the preference to the Spartans in ſuch a manner that the reſt of the Greeks could no longer bear his inſolence. On the contrary, Ariſtides, and Cimon the ſon of Miltiades, who commanded the Athenians, by their obliging behaviour gained the favour of every body; ſo that the allies, having publicly affronted Pauſanias, put themſelves under the protection of the Athenian republic; and thenceforward the Athenians, and not the Lacedemonians, had the ſupreme command.

93 Ariſtides taxes Greece with extraordinary applauſe.

The Greeks being now ſenſible that they would always have occaſion to be on their guard againſt the Perſians, and that it was neceſſary to eſtabliſh a fund by a common taxation of all the ſtates, Ariſtides was pitched upon as the only perſon that could be truſted with the power of allotting to each of the ſtates its proper quota. This difficult taſk he undertook, and executed in a manner unparalleled in the annals of hiſtory. All parties were pleaſed, and his taxation was ſtyled *the happy lot of Greece.* The groſs amount of it was 450 talents.

94 Themiſtocles baniſhed.

It now came to the turn of Themiſtocles to experience the ingratitude of his countrymen. His ſervices had been ſo eſſential, that the treatment he received may perhaps be a ſufficient excuſe for modern patriots when they connect their own intereſt with the ſervice of their country. Themiſtocles had plainly ſaved the ſtate from ruin by his advice; he had diſtinguiſhed himſelf by his valour; had rendered Athens, by his policy, ſuperior to the other ſtates of Greece; and entirely ſubverted the Lacedemonian ſcheme of power. Yet notwithſtanding all this he was baniſhed by the oſtraciſm, without the ſmalleſt crime pretended, unleſs that he was hated by the Lacdemonians, and that he had erected a temple, near his own houſe, dedicated to *Diana, the giver of the beſt counſel;* intimating that he himſelf had given the beſt council for the ſafety both of Athens and of all Greece, which was no more than the truth. Nay, he was not only driven out of Athens, but out of all Greece; ſo that he was forced to ſeek ſhelter from the king of Perſia, againſt whom he had fought with ſo much valour. That monarch gave him a gracious reception; and he was never recalled, becauſe the Greeks had no occaſion for his ſervices.

95 Succeſs of Cimon againſt the Perſians.

The war with Perſia was not yet diſcontinued; the Greeks found their advantage in plundering and enriching themſelves with the ſpoils of the king of Perſia's ſubjects. For this reaſon, in the end of the 77th Olympiad, they equipped a navy, under a pretence of relieving ſuch of the Greek cities in Aſia as were ſubject to the Perſians. Of this fleet Cimon, the ſon of Miltiades by the daughter of the king of Thrace, was appointed commander in chief. He had already taſted the juſtice and generoſity of his countrymen, having been thrown into priſon for his father's fine, from which he was releaſed by *Callias,* whom his ſiſter Elpinice married on account of his great wealth procured by no very honourable means. He accepted of the command, however; and gained ſuch immenſe booty in this expedition, that the Athenians were thereby enabled to lay the foundation of thoſe long extended walls which united the port to the city. The foundation was laid in a mooriſh ground; ſo that they were forced to ſink it very deep, and at a great expence; but to this Cimon himſelf contributed out of his own ſhare of the ſpoils, which was very conſiderable. He alſo adorned the forum with palm trees, and beautified the academy with delightful walks and fountains.

96 He ſubdues the Cherſoneſus.

The Perſians having ſoon after this expedition invaded Cherſoneſus, and with the aſſiſtance of the Thracians made themſelves maſters of it, Cimon was ſent againſt them in a great hurry. He had only four ſhips; but nevertheleſs with theſe he took 13 of the Perſian galleys, and reduced the whole of the Cherſoneſus. After this he marched againſt the Thracians, who revolting againſt the Athenians, had made themſelves maſters of the gold mines lying between the rivers Nyſſus and Strymon. The Thracians were quickly obliged to yield; after which the Athenians ſent a great colony to Amphipolis a city of Thrace, which for ſome time made a conſiderable figure, but afterwards attempting to penetrate into the country of the *Edones,* great part of them were deſtroyed.

97 Makes Athens irreſiſtable at ſea.

Cimon alſo fell upon the following expedient to make Athens irreſiſtable at ſea by the other ſtates of Greece. Many of the Greek ſtates, by virtue of Ariſtides's taxation, were bound to furniſh men and galleys, as well as to pay the tax for their ſupport. But when they ſaw themſelves out of danger from the Perſians, moſt of them were very unwilling to furniſh their quota of men. This the Athenian generals being offended with, were for having recourſe to force; but Cimon permitted ſuch as were deſirous of ſtaying at home to do ſo, and accepted a ſum of money in lieu of a galley completely manned. By this means he inured the Athenians, whom he took on board his galleys, to hardſhip and diſcipline; while the allies who remained at home became enervated through idleneſs, and from being confederates, dwindled into tributaries, and almoſt ſlaves. In the laſt year of the 77th Olympiad, Cimon was ſent to aſſiſt the Lacedemonians againſt the Helotes, who had revolted from them. In this he was attended with his uſual ſucceſs; but, ſome time after, the Lacedemonians being engaged in the ſiege of Ithome, ſent again to the Athenians for ſuccour, and Cimon was a ſecond time ſent to their relief; but the Spartans having received a ſufficient ſupply of troops from other quarters before the arrival of the Athenian general, he and his men were diſmiſſed without doing any thing. This grievouſly offended the people of Athens, who thenceforward hated not only the Lacedemonians, but all their own citizens who were thought to be friends to that ſtate.

98 He is baniſhed.

It was not poſſible, however, that any perſon who had ſerved the ſtate ſhould eſcape baniſhment at Athens. Cimon had gained great wealth both to the public and to himſelf. In his public character he had behaved with unimpeached honeſty, and as a private citizen he dedicated his wealth to the moſt excellent purpoſes. He demoliſhed the incloſures about his grounds and gardens, permitting every one to enter and take what fruits they pleaſed; he kept an open table,

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table, where both rich and poor were plentifully entertained. If he met a citizen in a tattered suit of clothes, he made some of his attendants exchange with him; or if the quality of the person rendered that kindness unsuitable, he caused a sum of money to be privately given him. All this, however, was not sufficient: he did not concur with every measure of the commonalty; and therefore the popular party determined not to banish him, but to put him to death. The crime laid to his charge was, that by presents from the Macedonians he was prevailed upon to let slip a manifest opportunity of enlarging his conquests, after taking from the Persians the gold mines of Thrace. To this accusation Cimon replied, that to the utmost of his power he had prosecuted the war against the Thracians and other enemies of the state of Athens; but that it was true he had not made any inroads into Macedonia, because he did not imagine he was to act as a public enemy of mankind, and because he was struck with respect for a nation modest in their carriage, just in their dealings, and strictly honourable in their behaviour towards him and the Athenians: that if his countrymen looked upon this as a crime, he must abide their judgment; but, for his part, he could never be brought to think such conduct amiss. Elpinice, Cimon's sister, used all her interest in his behalf, and amongst others spoke to Pericles the celebrated statesman and orator. He was indeed Cimon's rival, and had no doubt assisted in stirring up the prosecution against him; but he did not desire his death: and therefore, though appointed to accuse him, Pericles spoke in such a manner that it plainly appeared he did not think him guilty; and, in consequence of this lenity, Cimon was only banished by the ostracism.

The Athenian power was now risen to such an height, that all the other states of Peloponnesus looked upon this republic with a jealous eye, and were continually watching every opportunity of making war upon it when the state was engaged in troublesome affairs, and seemed to be less able to resist. These attempts, however, so far from lessening, generally contributed to increase the power of the Athenians; but in the year before Christ 458, the republic entered into a war with Sparta, which was scarce put an end to but by the destruction of the city of Athens. For this war, there was no recent provocation on the part of the Spartans. They had sent a great army to assist the Dorians against the Phocians, and the Athenians took this opportunity to revenge themselves of former quarrels. Having therefore drawn in the Argives and Thessalians to be their confederates, they posted themselves on the Isthmus, so that the Spartan army could not return without engaging them. The Athenians and their confederates amounted to 14,000, and the Spartans to 11,500. The Spartan general, however, not very willing to hazard a battle, turned aside to Tanagra, a city in Bœotia, where some of the Athenians who inclined to aristocracy entered into a correspondence with him. But before their designs were ripe for execution, the Athenian army marched with great expedition to Tanagra, so that a battle became inevitable. When the armies were drawing up in order of battle, Cimon presented himself before his countrymen in complete armour, and went to take post among those of his own tribe; but the popular party raised such a clamour against him, that he was forced to retire. Before he departed, however, he exhorted Euthippus and the rest of his friends to behave in such a manner that they might wipe off the aspersion thrown upon him, as if he had designed to betray his country's cause to the Lacedemonians. Euthippus desired him to leave his armour, which he did; and a battle ensuing, the Athenians were defeated with great loss, and Euthippus with the rest of Cimon's friends were all killed in defence of his armour which they had surrounded. Another engagement soon followed, wherein both armies suffered so much, that they were glad to conclude a short truce, that each might have time to recruit their shattered forces.

99 War between Athens and Sparta.

100 Athenians defeated.

101 They gain great advantages over the Spartans.

The scale of fortune now seemed to turn in favour of the Athenians. The Thebans, who had been deprived of the command of Bœotia on account of their having sided with Xerxes, were now restored to it by the Lacedemonians. At this the Athenians were so displeased, that they sent an army under Myronides the son of Callias into Bœotia to overturn all that had been done. That general was met by the Thebans and their allies, who composed a numerous and well-disciplined army. Nevertheless, though the Athenian army was but an handful in comparison of their enemies, Myronides gained a complete victory over the allies, in some sense more glorious than either that of Marathon or Platæa. In these battles they had fought against effeminate and ill-disciplined Persians, but now they encountered and defeated a superior army composed of the bravest Greeks. After this victory, Myronides marched to Tanagra; which he took by storm, and razed to the ground: he then plundered Bœotia; defeated another army which the Bœotians had drawn together to oppose him; then fell upon the Locrians; and, having penetrated into Thessaly, chastised the inhabitants of that country for having revolted from the Athenians, and from thence returned to Athens laden with riches and glory.

The next year Tolmides the Athenian admiral invaded Laconia, where he made himself master of several places; and on the back of this, Pericles invaded Peloponnesus with great success, burning, spoiling, or taking whatever places he attempted. On his return he found the people greatly out of humour on account of Cimon's banishment; so he was immediately recalled. 102 Cimon recalled.

Cimon was no sooner returned than he fell to his old employment of plundering the Persians; and, according to Plutarch, he had now nothing less in view than the conquest of the whole Persian empire. The Persian monarch finding he could have no rest, at last sent orders to Artabazus and Megabizus, his commanders, to conclude a treaty; which was done on the following conditions: 1. That the Greek cities in Asia should be free, and governed by their own laws. 2. That the Persians should send no army within three days journey of the sea. 3. That no Persian ship of war would sail between Thesalis and Cyrene, the former a city of Pamphylia, and the latter of Lycia.

103 His death.

While this treaty was carrying on Cimon died, whether of sickness or of a wound he had received is not known; and after his death the Athenian affairs began to fall into confusion. It was now the misfortune of this state to be alike hated by her enemies and allies; the consequence of which was, that the latter were perpetually

petually revolting whenever they thought they had an opportunity of doing so with impunity. The Megarians, at this time, who had been long under the protection or dominion of Athens, thought proper for some reason or other to disclaim all dependence on their former protectors, and have recourse to Sparta, with which state they entered into a strict alliance. This the Athenians revenged by ravaging the country of the Megarians; which soon brought on a renewal of the Lacedemonian war that had been for a little time suspended. Pericles, however, procured the return of the first Lacedemonian army, without bloodshed, by bribing Chandrides the young king of Sparta's tutor. In the winter, Tolmides resolved to undertake an expedition into Bœotia with a small body of troops; which design he put in execution contrary to the advice of

104 *A thirty years truce with the Lacedemonians.*

Pericles, and his rashness was soon punished by his own death and the total defeat of his army. Notwithstanding this misfortune, however, Pericles soon after invaded and reduced Euboea; and the Lacedemonians, finding it was not for their interest to carry on the war, concluded a truce with the Athenians for 30 years.

About this time Psammiticus, king of Egypt, sent by way of present to the people of Athens 40,000

105 *Cruelty of Pericles.*

bushels of wheat; which proved a great misfortune to the city: for Pericles, out of spite to Cimon, who had children by an Arcadian woman, had preferred a law whereby the Athenians of the half-blood were disfranchised; and this law, on account of the distribution of the corn abovementioned, was prosecuted with such severity, that no less than 5000 persons, who till then

106 *Number of the Athenian citizens.*

had been considered as free-men, were sold for slaves. This piece of cruelty has been of great service to the critics, as by means of it we know exactly the number of Athenian citizens, which at this time amounted to no more than 14,040 persons, though Athens was now aiming at no less than erecting an universal monarchy.

Six years after the conclusion of the peace between Athens and Sparta, a war broke out between the Samians and Milesians about the city of Priene, seated

107 *Samos reduced by Pericles.*

under mount Mycale in Ionia. How this war came to affect the Athenians is not certainly known: but somehow or other, this republic was induced to take the part of the Milesians; and the island of Samos was reduced by Pericles, who established there a democracy, and left an Athenian garrison. He was no sooner gone, however, than the Samians, disliking their new form of government, drove out the garrison he had left; but Pericles quickly returning, besieged and took their city, demolished their walls, and fined them of the whole expence of the war; part of which he obliged them to pay down, and took hostages for the remainder. When Pericles returned, he procured himself to be appointed to pronounce the public oration in honour of those who fell; which he did with such eloquence, that when he came down from the pulpit the women gathered about him, took him by the hand, and crowned him with garlands.

108 *War between the Corcyrians and Corinthians.*

A little after this commenced the war between the Corcyrians and Corinthians, which by degrees brought the Athenians into those engagements that proved the ruin of their state. The causes of this war were the following. An intestine war breaking out in the little territory of Epidamnum, a city of Macedonia founded by the Corcyrians, one party called in to their assistance the Illyrians, and the other the Corcyrians. The latter neglecting the matter, Corinth was applied to, as the Corcyrians were a colony from that place. The Corinthians, partly out of pity to the Epidamnians, and partly out of spleen to the Corcyrians, sent a very great fleet to the assistance of the former, by which means that party which had applied to Corinth was thoroughly established. This being resented by the Corcyrians, they sent a fleet to Epidamnum to support the exiles; and accordingly this fleet began to act offensively on its entering the port, the chief commanders having instructions to propose terms of accommodation, to which the Corinthians would by no means agree. The next year the Corcyrians defeated at sea the Corinthians and their allies, and took Epidamnum by storm; after which they wasted the territories of the allies of the Corinthians, which greatly exasperated the latter. At Corinth, therefore, they began to make great preparations for carrying on the war, and pressed their confederates to do the same, that they might be in a condition to retrieve the honour they had lost, and humble this ungrateful colony which had thus insulted her mother-city.

The Corcyrians were no sooner acquainted with these proceedings, than they dispatched ambassadors to Athens with their complaints; and these were quickly followed by others from Corinth on the same errand. At first the people of Athens inclined to favour the Corinthians; but they soon changed their minds, and took part with the Corcyrians: they contented themselves, however, with entering into a defensive alliance with that little state, whereby they promised to assist each other, in case either party should be attacked; and in consequence of this treaty, they furnished the Corcyrians with ten galleys, under Lacedæmonius the son of Cimon, with whom were joined Diotenes and Proteus as colleagues.

109 *Athens sides with the Corcyrians.*

As soon as the season of the year permitted, the Corinthians sailed for the coast of Corcyra with a fleet of 150 ships, under the command of Xenoclides assisted by four other Corinthian admirals; each squadron of their allies being commanded by a chief of their own. The Corcyrian and Athenian fleet amounted to 120, but the Athenians had orders to give as little assistance as possible. The action was very brisk for some time: the Corcyrian right wing broke the left of the Corinthian fleet; and forcing some of the ships on shore, landed, pillaged their camp, and made a great number of them prisoners: on the other hand, the Corinthian ships in their right wing beat the Corcyrian ships there, they being but very faintly assisted by the Athenians, till the latter were at last obliged to defend themselves, which they did so well, that the Corinthians were glad to retire. The next day preparations were made on both sides for another engagement; but 20 ships coming from Athens to the assistance of the Corcyrians, the Corinthians declined the combat.

110 *Potidæa besieged by the Athenians.*

As soon as the Corcyrian war broke out, the Athenians sent orders to the citizens of Potidæa to demolish a part of their wall, to send back the magistrates they had received from Corinth, and to give hostages for their own behaviour. Potidæa was a town in Macedonia,

donia, founded by the Corinthians, but at that time in alliance with the Athenians. Perdiccas king of Macedon, who hated the Athenians, took this opportunity to perſuade the Potidæans to revolt. Accordingly they ſent ambaſſadors to Athens to intreat the revocation of theſe orders: but at the ſame time ſent deputies to Sparta, to join with the Corinthians and Megarians in their complaints againſt the Athenians. The Athenians upon this ſent a conſiderable fleet againſt Potidæa under the command of Calias, a nobleman of great courage. The Corinthians on their part diſpatched one Ariſteus with a conſiderable body of troops to the aſſiſtance of that city. An engagement following, the Athenians were victors, but with the loſs of their general. Phormio, who ſucceeded in the command, inveſted the city in form, and ſhut up its port with his fleet; but the Potidæans dreading to fall into the hands of the Athenians, made a moſt obſtinate defence, while in the mean time they warmly ſolicited the Corinthians to perform their promiſes, and engage the reſt of the ſtates of Peloponneſus in their quarrel.

111
The Spartans demand reparation for the injuries offered to the ſtates of Greece.

The Lacedemonians having heard what the Corinthians, and other little ſtates of Greece had to ſay againſt the Athenians, ſent ambaſſadors to the latter, demanding reparation for the injuries, with orders, in caſe of a refuſal to declare war. The terms demanded were, in the firſt place the expulſion of thoſe Athenians who were allied to the family of Megacles ſo often mentioned. This article was on account of Pericles; for he was the ſon of Xanthippus the Athenian commander at Mycale, by Agariſte niece to the famous Clyſthenes, who corrupted the prieſteſs of Apollo in order to procure the expulſion of the Piſiſtratidæ. They next inſiſted that the ſiege of Potidæa ſhould be raiſed; thirdly, that the inhabitants of Ægina ſhould be left free; and, laſtly, that a decree made againſt the Megarians, whereby they were forbid the ports and markets of Athens, ſhould be revoked, and all the Grecian ſtates under the dominion of Athens ſet at liberty.

112
Their terms rejected by advice of Pericles.

Theſe terms the Athenians were perſuaded by Pericles to reject. The arguments uſed by him were in ſubſtance as follows: That whatever the Lacedemonians migh pretend as to the juſtice of the complaints of the allies, the true ground of this reſentment was the proſperity of the Athenian republic, which the Spartans always hated, and now ſought an opportunity of humbling; that it muſt be owing to the Athenians themſelves if this deſign ſucceeded, becauſe for many reaſons Athens was better able to engage in a long and expenſive war than the Peloponneſians. He then laid before the people an exact account of their circumſtances; putting them in mind, that the treaſure brought from Delos amounted to 10,000 talents; and that tho' 4000 of theſe had been expended on the ſtately gate of their citadel, yet that 6000 were ſtill in hand; that they were alſo intitled to the ſubſidies paid by the confederate ſtates; that the ſtatues of their gods, the Perſian ſpoils, &c. were worth immenſe ſums; that private men were arrived at vaſt fortunes; and that, conſidering their trade by ſea, they had a certain annual increaſe of wealth; that they had on foot an army of 12,000 men, and in their colonies and garriſons 17000; that their fleet conſiſted of 300 ſail; whereas the Peloponneſians had no ſuch advantages. For theſe reaſons he propoſed as the moſt feaſible, and likewiſe the moſt equitable ſatisfaction that could be given, that they would reverſe their decree againſt Megara, if the Lacedemonians would allow free egreſs and regreſs in their city to the Athenians and their allies; that they would leave all thoſe ſtates free who were free at the making of the laſt peace with Sparta, provided the Spartans would alſo leave all ſtates free who were under their dominion; and that future diſputes ſhould be ſubmitted to arbitration. In caſe theſe offers ſhould be rejected, he adviſed them to hazard a war; telling them, that they ſhould not think they ran that hazard for a trifle, or retain a ſcruple in their minds as if a ſmall matter moved them to it, becauſe on this ſmall matter depended their ſafety, and the reputation of their conſtancy and reſolution; whereas, if they yielded in this, the next demand of the Lacedemonians would be of a higher nature; for having once diſcovered that the Athenians were ſubject to fear, they would thence conclude that nothing could be denied to Sparta, whereas a ſtiff denial in this caſe would teach them to treat Athens for the future on terms of equality. He enforced theſe reaſons by ſhowing that their anceſtors had always acted on the like principles, and in all caſes preferred their glory to their eaſe, and their liberty to their poſſeſſions.

This was the origin of the Peloponneſian war, which makes ſo great a figure in ancient hiſtory. The immediate preliminary to general hoſtilities was an attempt of the Thebans to ſurpriſe Platæa. With this 113
Attempt of the Thebans on Platæa.

view they ſent Eurymachus with 300 Thebans to aſſiſt ſuch of the Platæans as they had drawn over to their intereſt, in making themſelves maſters of the place. In this deſign they ſucceeded very well at firſt, the Platæans who had promiſed to open the gates keeping their words exactly, ſo that they were inſtantly in poſſeſſion of the city. The other party, however, perceiving how ſmall a number they had to contend with, unanimouſly roſe upon them, killing a great many, and forced the reſt to ſurrender themſelves priſoners of war. Another party came from Thebes to aſſiſt their countrymen; but they arrived too late: the Platæans, however, foreſeeing that they would waſte their country, promiſed to releaſe their priſoners if they 114
They are maſſacred.

would forbear to ſpoil their lands. On this the Thebans withdrew; and the Platæans cruelly put to death all their priſoners, to the number of 180, with Eurymachus their chief, alledging that they had not promiſed their releaſe but in caſe of peace. The Athenians, as ſoon as they had notice of this attempt of the Thebans, cauſed all the Bœotians in their territory to be arreſted; and when they underſtood how the Platæans had delivered themſelves, they ſent a great convoy of proviſions to that city, and a numerous body of troops to eſcort their wives and children to Athens.

115
Account of the allies on both ſides.

Both parties now prepared in earneſt for war, both ſent ambaſſadors to the Perſians, and both ſought to rouſe their allies. Moſt of the Greek ſtates inclined to favour the Spartans, becauſe they acted on this occaſion as the deliverers of Greece, and becauſe they either had been, or feared that they would be, oppreſſed by the Athenians. With the Spartans joined all the Peloponneſians, except the Argives and part of the A-

Attica.

chæans; without Peloponneſus, the Megarians, Phocians, Locrians, Bœotians, Ambraciots, Leucadians, and Anactorians, declared themſelves on their ſide. On the other hand, the Chians, Leſbians, Platæans, Meſſenians, Acarnanians, Corcyrians, Zacynthians, Carians, Dorians, Thracians, moſt part of the iſlands, and all the Cyclades excepting Melos and Thera, with Eu-

116 bœa and Samos, joined the Athenians.

First year of the war.

The Peloponneſian war commenced 431 years before Chriſt. The Lacedemonian army was aſſembled at the Iſthmus, and conſiſted of no leſs than 60,000 men; but before Archidamus king of Sparta, who commanded in chief, would enter Attica, he diſpatched a herald to Athens. The herald was ſent back without any anſwer, by which all hopes of peace were cut off. As Archidamus was a friend to Pericles, the latter apprehended that he might forbear plundering his eſtates. With this he immediately acquainted the people; telling them at the ſame time, that in ſuch a caſe he made a preſent of his lands to the public. He then adviſed the citizens to take no care of defending their country-ſeats, but to attend only to the city, buſy themſelves in the equipping of ſhips, and ſettle a thorough reſolution not to be intimidated with the firſt evils of war. This propoſal the Athenians readily complied with, and appointed Pericles commander in chief, with nine more generals to aſſiſt him.

The firſt year; the Spartan army committed great ravages in Attica, Pericles having no force capable of oppoſing it, and refuſing to engage on diſadvantageous terms, notwithſtanding prodigious clamours were raiſed againſt him by his countrymen. The allies, however, had no great reaſon to boaſt of the advantages they gained this year: an Athenian fleet ravaged the coaſts of Peloponneſus; another infeſted the Locrians, drove out the inhabitants of Ægina, and repeopled the iſland from Athens. They likewiſe reduced Cephalenia, and ſome towns in Acarnania and Leucas which had declared for the Lacedemonians; and in the autumn, when the Peloponneſians were retired, Pericles entering the Megarian territory, did all the miſchief that

117 could be expected from a provoked enemy.

Second year. A dreadful plague at Athens.

The ſpring of the ſecond year was very fatal to Athens by a dreadful plague which deſtroyed great numbers of the citizens, while the Peloponneſians under Archidamus waſted every thing abroad. In the midſt of theſe diſtreſſes, however, Pericles retained his courage, and would ſuffer none of his countrymen to ſtir without the city, either to eſcape the plague or infeſt the enemy. He cauſed a great fleet to be equipped, on board which he embarked 4000 foot and 300 horſe, with which he ſailed to Epidaurus. Upon this the enemy withdrew their forces out of Attica; but Pericles was able to do no great matter on account of the plague, which made ſo great havock among his men,

118 that he brought back to Athens only 1500 of the 4000

Athenians ſue for peace.

he carried out. By this misfortune the Athenians were thrown into deſpair; they immediately ſued for peace, which the Spartans were now too proud to grant; then turning their rage upon Pericles, they diſmiſſed and fined him. Soon after, Pericles's children and almoſt all his relations died of the plague; ſo that this great ſtateſman was overwhelmed with melancholy, and for ſome time ſhut himſelf up from public view: at laſt, through the perſuaſion of Alcibiades and ſome others, he ſhowed himſelf to the people. They received him with acclamations, and at his requeſt repealed the un- 119

Pericles requeſts the repeal of his law.

juſt law he had made, whereby all the Athenians of the half blood were disfranchiſed, and then reinſtated him in all his former honours. Hereupon he inrolled the only ſon he had left, who before had been counted a baſtard on account of his mother being a Mileſian.

This year alſo the iſland of Zacynthus was waſted by the Peloponneſians; and the city of Potidæa ſubmitted to the Athenians, after the inhabitants had been driven to ſuch extremity as to feed upon human fleſh. The Athenians permitted the men to depart with one garment, and the women with two; after which, the town was repeopled by a colony from Athens. 120

Third year. Pericles dies.

The third year of the Peloponneſian war was remarkable for the death of the great Pericles, who was taken off by the plague. Platæa was alſo beſieged by Archidamus; but without ſucceſs, even though the 121

Platæa beſieged.

greateſt part of it was ſet on fire, the Platæans reſolving to ſubmit to every kind of miſery rather than abandon the Athenian cauſe. In the end, therefore, the king of Sparta was obliged to turn the ſiege into a blockade; and having thrown up an entrenchment fortified with a deep ditch, he left a ſufficient number of men to guard his lines, and then returned back to Peloponneſus. 122

Fourth year. Deſperate attempt of the Platæans.

The following ſummer the Peloponneſians under the command of Archidamus invaded Attica, where they waſted every thing with fire and ſword; at the ſame time the whole iſland of Leſbos, except the diſtrict of Methymna, revolted from the Athenians, who hereupon inveſted the city of Mitylene. All this time the city of Platæa was blocked up by the Peloponneſians; and its inhabitants being now greatly diſtreſſed for want of proviſions, the garriſon, conſiſting of 400 natives and 80 Athenians, came to the deſperate reſolution of forcing a paſſage through the enemy's lines. When they came to attempt this, however, many of them were intimidated: but 300 perſiſted in their reſolution; and of theſe 212 got ſafe through and marched to Athens, but the reſt were compelled to retire. 123

Fifth year. Mitylene, &c. taken by the Athenians.

In the beginning of the fifth year, the Peloponneſians ſent 40 ſhips to the relief of Mitylene; but without effect, for the place had ſurrendered before the fleet could come to its aſſiſtance. Paches, the Athenian commander, likewiſe chaſed away the Peloponneſian fleet upon its arrival; and returning to Leſbos ſent the Lacedemonian miniſter, whom he found in Mitylene, together with a deputation, to Athens. On their arrival the Lacedemonian was immediately put to death; and in a general aſſembly of the people, it was reſolved, that all the Mitylenians who had arrived at man's eſtate ſhould be put to death, and the women and children ſold for ſlaves. The next day, however, this cruel decree was reverſed, and a galley ſent with all expedition to countermand theſe bloody orders. This laſt veſſel, however, could not get before the other: but Paches, being a man of great humanity, had taken a day to conſider on the orders he had received; during which time the laſt mentioned galley arrived; in conſequence of which, only about 1000 of the moſt forward rebels were put to death; the walls of the city were alſo demoliſhed, their ſhips taken away, and their lands divided among the Athenians, who let them again to their old maſters at very high rents. The ſame ſummer

mer the Athenians seized the island of Minoas, lying over against the territory of Megara: and likewise the port Nisæa, which last they fortified, and it proved afterwards a place of the utmost importance to them.

124 **Platæa taken and razed.**

At this time also the Platæans, driven to the last extremity, surrendered to the Lacedemonians, by whom they were, to the number of 208, including 25 Athenians, put to death, and their women sold for slaves. Their city was soon after razed by their implacable enemies the Thebans, who left only an inn to show where it stood. The fame of Platæa, however, induced Alexander the Great afterwards to rebuild it.

125 **Sedition of Corcyra.**

In this year happened the famous sedition of Corcyra, whence other seditions, when their effects rendered them terrible, have been called *Corcyrian*. It hath been already observed, that the war between the Corcyrians and Corinthians brought on the general war throughout Peloponnesus. A great number of Corcyrians were in the beginning of this war carried away prisoners into Peloponnesus, where the chief of them were very well treated, but the rest sold for slaves. The reason of this conduct of the Corinthians was a design they had formed of engaging these Corcyrians to influence their countrymen to side with them and their allies. With this view they treated them with all imaginable lenity and tenderness, instilling into them by degrees an hatred of democratic government; after which they were told, that they might obtain their liberty upon condition of using all their influence at home in favour of the allies, and to the prejudice of Athens. This the Corcyrians readily promised, and endeavoured to perform. At first, those who were for an aristocracy prevailed, and murdered all those of the opposite party that fell into their hands, in which they were assisted by a fleet of Peloponnesians: but the Athenians sending first one fleet and then another to the assistance of the distressed party, the Peloponnesians were forced to withdraw; after which, the democratic party sufficiently revenged themselves, and destroyed their antagonists without mercy. The worst of all was, that, this example once set, the several states of Greece felt in their turns the like commotions, which were always heightened by agents from Sparta and Athens; the former endeavouring to settle aristocracy, and the latter democracy, wherever they came.

126 **Athenians engage in a war with Sicily.**

While the Athenians were thus engaged in a war wherein they were already overmatched, they foolishly engaged in a new one, which in the end proved more fatal than all the rest. The inhabitants, of Sicily were split into two factions; the one called the *Doric*, at the head of which was the city of Syracuse; the other the *Ionic*, which owned the Leontines for their chiefs: the latter perceiving themselves too weak without foreign aid, sent one Georgias, a celebrated orator, to apply to Athens for relief; and he by his fine speeches so captivated the giddy and inconstant Athenians, that they ran headlong into a war which they were unable to maintain, while engaged with all the Peloponnesians. Enticed by this new prospect, therefore, and grasping at the conquest of Sicily, as well as of all Greece, they sent a fleet to the assistance of the Leontines, under the command of Lachetes and Chabrias; and they were no sooner sailed, than another fleet for the same purpose was begun to be fitted out. All this time the plague continued to rage with great violence at Athens, cutting off this year 4000 citizens, besides a much greater number of the meaner sort of people.

127 **Sixth year.**

The sixth year of the Peloponnesian war was remarkable for no great exploit: Agis the son of Archidamus, king of Sparta, assembled an army in order to invade Attica, but was prevented from so doing by many great earthquakes which happened throughout Greece.

128 **Seventh year.** **Pylus fortified by the Athenians.**

The next year, however, he entered Attica with his army, while the Athenians on their part sent a fleet under the command of Demosthenes, to infest the coasts of Peloponnesus. As this fleet passed by Laconia, the commander took notice that the promontory of Pylus, which was joined to the continent by a narrow neck of land, had before it a barren island about two miles in circumference, in which, however, there was a good and safe port, all winds being kept off by the headland, or by the isle. These advantages made him apprehend, that a garrison left here would give the Peloponnesians so much trouble, that they would find it more adviseable to protect their own country than to invade that of their neighbours. Accordingly, having raised a strong fortification, he himself with five ships staid to defend it, while the rest of the fleet proceeded on their intended expedition.

129 **Besieged.**

On the news of this event, the Peloponnesian army immediately returned to besiege Pylus. When they arrived before the place they took possession of the harbour, and then caused a chosen body of Spartans to take possession of the island of Sphacteria, after which they attacked the fort with great vigour. Demosthenes and his garrison defended themselves with great valour; and an Athenian fleet arriving very seasonably, offered battle to the Peloponnesian fleet.

130 **Spartan fleet destroyed.**

This being refused, the Athenians boldly sailed into the harbour, broke and sunk most of the vessels therein, after which they besieged the Spartans in Sphacteria. The Peloponnesians now began to treat with their enemies, and a truce was concluded during the time that negociations were carried on at Athens. One of the articles of this truce was, that the Peloponnesians should deliver up all their ships, on condition of having them punctually returned in case the treaty did not take effect. The Athenians having heard the Spartan ambassadors, were inclined to put an end to this destructive war: but Cleon, one of their orators, a warm and obstinate man, persuaded his countrymen to insist on very unreasonable terms; upon which the ambassadors returned, and by so doing put an end to the truce.

131 **Treachery of the Athenians.**

The Peloponnesians then demanded their vessels; but the Athenians refused to deliver them, under pretence of their having broke the truce.

132 **They attack Sphacteria.**

Hostilities being thus recommenced on both sides, the Lacedemonians attacked the Athenians at Pylus, while the latter attacked the Spartans at Sphacteria. The Spartans, though but an handful of men and under every imaginable discouragement, behaved with such bravery, that the siege proceeded very slowly, so that the people of Athens became very uneasy.

133 **Cleon the orator appointed general.**

They began then to wish they had embracced the offers of the Spartans, and to rail vehemently against Cleon, who, to excuse himself, said, it would be easy for the general of the forces they were at that time sending, to attack the Spartans in the isle, and reduce them at once. Nicias, who had been appointed to this command, replied, that if Cleon believed he could do such great things, he

he would do well to go thither in person: the latter, imagining this only meant to try him, said he was ready to go with all his heart; whereby Nicias catched him, and declared that he had relinquished his charge. Cleon thereupon said, that he was no general: but Nicias told him that he might become one; and the people, pleased with the controversy, held the orator to his word. Cleon then advancing, told them he was so little afraid of the enemy, that, with a very inconsiderable force, he would undertake, in conjunction with those already at Pylus, to bring to Athens the Spartans
134 who gave them so much trouble in 20 days. The people laughed at these promises: however, they furnished him with the troops he desired; and to their surprise, Cleon brought the Spartans prisoners to Athens within the time appointed.

He takes the place.

135 This summer, likewise, an Athenian fleet was sent to Sicily, with instructions to put in at Corcyra, and assist the government against the Lacedemonian faction which still subsisted in that island. This they effectually performed; for by their means the exiles fell into the hands of the other party: these they imprisoned; and then drew them out by 20 at a time, to suffer death, which was inflicted with all the circumstances of cruelty that party-rage could suggest. When only 60 remained, they intreated the Athenians to put them to death, and not to deliver them up to their countrymen: but upon this the Corcyrians surrounded the place where they were confined, endeavouring to bury them under their darts; upon which the unhappy captives all put an end to their own lives.

End of the Corcyrian sedition.

136 In the eighth year Nicias reduced the isle of Cythera on the coast of Laconia; as likewise Thyræa, on the confines of that country. The latter had been given to the Æginetans when expelled from their own country by the Athenians: and they were now condemned to death, as inveterate enemies of the Athenian state and nation.—In Sicily, one Hermocrates of Syracuse persuaded all the inhabitants of the island to adjust their differences among themselves; upon which the Athenian generals returned home, and for so doing two of them were banished, and the third sentenced to pay a heavy fine.

Eighth year. Success of the Athenians.

The Athenians next laid siege to Megara under the conduct of Hippocrates and Demosthenes; but Brasidas a Spartan general coming to its relief, a battle en-
137 sued, by which, though neither party got the better, the Lacedemonian faction prevailed in Megara, and many who favoured the Athenians were forced to withdraw. After this, such as had been banished for adhering to the Lacedemonians were allowed to return, on their taking an oath to forget what was past, and attempt nothing that might disturb their country. As soon as they were settled, however, they forgot their oath; and causing 100 of those who were most obnoxious to be apprehended, forced the people to condemn them to death. They then changed the whole form of government, introduced an oligarchy, and possessed
138 themselves of the supreme power.

Spartan party prevails in Megara.

In Bœotia some commotions were raised in favour of the Athenians; but their generals Hippocrates and Demosthenes being defeated by the opposite party, all hopes ceased of the Athenian power being established in Bœotia. In the mean time Brasidas reduced the city of Amphipolis, which greatly alarmed the Athenians, who thereupon sent new supplies of men, money, and ships to the Macedonian coast; but all their care could not prevent a great desertion from their interest in those parts, where the valour and conduct of Brasidas carried all before him. 139

Athenians lose their power in Bœotia.

In the ninth year, the Spartans made new proposals of peace, which the Athenians were now more inclined to accept than formerly; and finding their affairs very much unsettled by the loss of Amphipolis, a truce for a year was quickly agreed on, while negociations were in the mean time carrying on for a general peace. This pacific scheme, however, was very soon overthrown by the following accident in Thrace. The city of Scione, and that of Menda, revolted to Brasidas; who, knowing nothing of the truce, sought to draw over Potidæa also. The Athenians, pretending that Scione revolted two days after the truce was concluded, made heavy complaints, asserting that this was a breach of the truce, and that both it and Menda should be restored to them. This not being effected by negociations, an army was sent against the two cities, by which Menda was reduced; but Scione making an obstinate defence, the siege was turned into a blockade. 140

Ninth year. A truce concluded and broken.

In the tenth year, Brasidas made an attempt upon Potidæa; which having failed, the Athenians began to recover some courage. The truce expiring on the day of the Pythian games, Cleon persuaded the Athenians to send an army into Thrace under his command. It consisted of 1200 foot and 300 horse, all Athenian citizens, who embarked on board 30 galleys. Brasidas had an army much inferior; but observing that the Athenian general was become careless, and neglected discipline, he attacked him. In this engagement Cleon was killed, and the Athenians defeated with the loss of 600 men, while the Spartans lost only seven; but among these was their great commander Brasidas, whose death affected them almost as much as the loss of their army did the Athenians. 141

Tenth year Cleon defeated and killed by Brasidas.

As the death of Cleon deprived the Athenians of one of their best speakers, and one who had been very industrious in promoting the war, they were now much more disposed than formerly to hearken to terms of accommodation. Amongst the Spartans, too, there was a party, at the head of whom was Plistonax their king, who earnestly wished for peace; and as Nicias laboured no less assiduously at Athens to bring about this desirable event, a peace was at last concluded for fifty years between the two nations. The conditions were, that a restitution of places and prisoners should be made on both sides; excepting that Nisœa should remain to the Athenians, who had taken it from the Megarians; and that Platæa should continue with the Thebans, because they absolutely would not give it up. The Bœotians, Corinthians, and Megarians, refused to be included in this peace: but the rest of the allies yielded to it; and it was accordingly ratified, receiving the name of the *Nician* peace, from Nicias who had so vigorously promoted it. 142

A fifty years peace

By this means, however, tranquillity was far from being restored. Such of the states of Peloponnesus as were dissatisfied, began immediately to league among themselves, and to set on foot a new confederacy, the head of which was to be the state of Argos. The Lacedemonians, too, found it impossible to perform exactly the articles of agreement; the city of Amphipolis in

New discontents.

in particular, absolutely refused to return under the Athenian government; for which reason the Athenians refused to evacuate Pylus. In the winter, new negociations were entered into on all sides, but nothing determined, and universal murmuring and discontent took place.

143 Heightened by Alcibiades.

These discontents were not a little heightened by Alcibiades, who now began to rival Nicias, and, perceiving the Lacedemonians made their court mostly to his rival, took all opportunities to incense his countrymen against that nation. Nicias, on the other hand, who wished for nothing so much as a peace, used all his endeavours to bring about a reconciliation. The artifices of Alcibiades, however, added to the turbulent and haughty disposition of both nations, rendered this impossible; so that though Nicias went on purpose to Sparta, he returned without doing any thing.

144 His measures for the safety of Attica.

Alcibiades having thus disposed every thing according to his wishes, and a war being inevitable, he began to take the most prudent methods for preserving his country in safety. With this view he entered into a league for 100 years with the Argives, which he hoped would keep the war at a distance: he next passed over into the territories of Argos, at the head of a considerable army; and laboured, both at that city and at Patræ, to persuade the people to build walls to the sea, so that they might the more easily receive assistance from the Athenians. But though great preparations for war were now made, nothing was undertaken this year; only the Argives thought to have made themselves masters of Epidaurus, but were hindered by the Lacedemonians putting a garrison into it.

145 Fourteenth year. War renewed.

The next year, (the 14th after the Peloponnesian war was first begun) a Spartan army, under the command of Agis, entered the territory of Argos where the confederate army lay; but just as the engagement was about to begin, a truce was suddenly concluded by two of the Argive generals and the king of Sparta. With this neither party was pleased, and both the king and generals were very ill treated by their citizens.

146 Athenians, &c. defeated at Mantinea.

On the arrival of some fresh troops from Athens, therefore, the Argives immediately broke the truce: but the allied army was soon after defeated with great slaughter by Agis; notwithstanding which, however, the Eleans and Athenians invested Epidaurus. In the winter, a strong party in Argos joined the Lacedemonians; in consequence of which that city renounced her alliance with Athens, and concluded one with Sparta for 50 years. In compliment to their new allies, also, the Argives abolished democracy in their city, establishing an aristocracy in its place, and assisted the Lacedemonians with a considerable body of troops to force the Sicyonians to do the same.

147 Fifteenth year.

In the beginning of the 15th year, the Argives, with a levity seemingly natural to all the Greeks, renounced their alliance with Sparta, abolished aristocracy, drove all the Lacedemonians out of the city, and renewed their league with Athens. The Athenians, in the mean time, being convinced of the treachery of Perdiccas king of Macedon, renounced their alliance with him, and declared war against him.

148 Sixteenth year. Melos reduced by the Athenians.

Next year Alcibiades terminated the disputes in the city of Argos, by the banishment of the Spartan faction; after which he sailed to the island of Melos, whose inhabitants had acted with the greatest inveteracy against his countrymen: perceiving, however, that the reduction of the island would be a work of time, he left a considerable body of forces there, and returned to Athens. In his absence the capital of Melos surrendered at discretion, and the inhabitants were treated with the utmost cruelty; all the men capable of bearing arms being slaughtered, and the women and children carried into captivity.

149 Seventeenth year. Athenian army in Sicily lost, and Alcibiades flies to Sparta.

In the beginning of the 17th year, Nicias was appointed commander of an expedition against the Syracusans, along with Alcibiades and Lamachus as colleagues. But while the necessary preparations were making, all things were thrown into confusion by the defacing of the Hermæ, or statues of Mercury, of which there was a great number in the city. The authors of this sacrilege could by no means be discovered, though rewards were offered for this purpose; at last the suspicion fell upon Alcibiades; and for this weighty reason he was commanded to return from Sicily to take his trial. Alcibiades, however, knew the temper of his countrymen too well to trust himself to their mercy; and therefore, instead of returning to Athens, he fled immediately to Sparta, where he met with a gracious reception; while the infatuated Athenians were severely punished by the loss of their armies, generals, and fleet, in Sicily, which the superior abilities of Alcibiades would in all probability have prevented.

150 Nineteenth and twentieth years, &c.

The 19th and 20th years of the war were spent by the Athenians in equipping a new fleet in order to repair their vast losses: but Alcibiades hurt their interests very much, by persuading Tissaphernes the Persian to league with the Spartans against them; at the same time he persuaded several of the Ionian states to revolt from Athens, but they were in a short time obliged again to submit.

151 Alcibiades flies to Persia.

Notwithstanding all these services, however, Alcibiades had rendered himself so hateful to Agis by debauching his wife, that he soon found himself obliged to fly to the Persians, where Tissaphernes gave him a very favourable reception, and profited much by his advice, which was to let the Greeks weaken one another by their mutual wars, and that the Persians ought never to see one state totally destroyed, but always to support the weaker party.

152 Proposes the abolition of democracy at Athens.

When Tissaphernes had acquiesced with these counsels, Alcibiades privately wrote to some of the officers in the Athenian army at Samos, that he had been treating with the Persians in behalf of his countrymen, but did not choose to return till the democracy should be abolished; and to incline the citizens to comply with this measure, he told them that the Persian king disliked a democracy, but would immediately assist them if that was abolished, and an oligarchy erected in its stead.

On the arrival of Pisander and other deputies from the army, with the proposals of Alcibiades, the Athenians without hesitation resolved to overturn that democracy which they had all along so strenuously defended. The issue of their present debates was, that Pisander with ten deputies should return to Alcibiades, in order to know on what terms the king of Persia would make an alliance with them; but that cunning Athenian having perceived that Tissaphernes was by no means disposed to assist the Athenians on account of their having been lately successful, he set up such high demands in the king of Persia's name, that the Athenians of themselves broke off the treaty, and

and thus Alcibiades preserved the friendship of both parties.

Pisander having engaged the army at Samos in his scheme of overturning democracy, that form of government was abolished first in the cities subject to Athens, and lastly in the capital itself. Pisander's new scheme was, That the old form of government should be totally dissolved: that five prytanes should be elected: that these five should choose 100; and that each of the hundred should choose three: that the 400 thus elected should become a senate with full power; but should occasionally consult with 5000 of the most wealthy citizens, who should thenceforward be esteemed only *the people;* and that no authority should remain with the lowest class. Though the people were not very fond of this change, those who conducted it, being men of great parts found means to establish it by force; for when the people were gone out of the city to their ordinary employments, the 400, having each a dagger concealed under his vest, attended by a guard of 120 men, entered the senate-house, dissolved the old senate, and without ceremony turned them out; after which the commons, not knowing whom to submit to, or to whom to apply, made no opposition.

153 New form of government established.

The first step of the new governors was to destroy all their enemies; who, however, were not very numerous, so that little blood was shed. They next sent ambassadors to Agis to sue for peace; but he, taking for granted that the Athenians would never defend an oligarchy, gave no answer to the ambassadors, but immediately marched towards the capital with a design to attack it. On his arrival, however, he was quickly convinced of his mistake, being repulsed with loss, and obliged to retire to his old post.

154 The army declare for democracy, and recall Alcibiades.

In the mean time the Athenian army declared again for a democracy, and having recalled Alcibiades, invested him with full power, and insisted on his immediate return to Athens to restore the ancient government. This measure he refused to comply with, and persuaded them to stay where they were, in order to save Ionia: he also prevailed on them to allow some deputies, who had been sent from the new governors of Athens, to come and deliver their message. To these deputies Alcibiades replied, that they should immediately return to Athens, and acquaint the 400, that they were commanded immediately to resign their power and restore the senate; but that the 5000 might retain theirs, provided they used it with moderation.

155 Great confusion at Athens.

By this answer the city was thrown into the utmost confusion; but the new government party prevailing, ambassadors were dispatched to Sparta with orders to procure peace on any terms. This, however, was not to be effected; and Phrynicus, the head of the embassy, and likewise of the new government party, was murdered on his return. After his death, Theramenes the head of the other party, seized the chiefs of the 400; upon which a tumult ensued that had almost proved fatal to the city itself. The mob, however, being at last dispersed, the 400 assembled, though in great fear, and sent deputies to the people, promising to set all things to rights. In consequence of this deputation, a day was appointed for convoking a general assembly, and settling the state; but when that day came, news was brought that the Lacedemonian fleet appeared in view, and steered directly for Salamis. Thus all was again thrown into confusion; for the people, instead of deliberating on the subject proposed, ran in crowds down to the port, and perceiving the Spartans made towards Euboea, a fleet of 36 ships was immediately dispatched under the command of Thymochares, to engage the enemy. This fleet was utterly defeated, 22 of the Athenian ships being taken, and most of the others sunk or disabled; but what was worse, this defeat was followed by the revolt of all the country of Euboea except Orcus.

156 Athenian fleet destroyed by the Spartans.

When these dismal tidings arrived at Athens, every thing was given up for lost; and had the Lacedemonians taken this opportunity of attacking the city, they had undoubtedly succeeded, and thus put an end to the war: but being at all times slow, especially in naval affairs, they gave the Athenians time to equip a new fleet, and to retrieve their affairs. One good effect of this disaster, however, was the putting an end for a time to the internal dissensions of this turbulent people; insomuch that Thucydides the historian is of opinion, that the republic never enjoyed so much quiet as at this time.

157 Exploits of Alcibiades.

Alcibiades now showed his abilities and inclination to serve his country in an eminent manner. By his intrigues he so effectually embroiled the Persians and Peloponnesians with each other, that neither party knew whom to trust. Thrasybulus, with 55 ships, gained a victory over the Peloponnesian fleet consisting of 73: after which he took 8 galleys coming from Byzantium; which city had revolted from the Athenians, but was soon after taken, and the inhabitants severely fined. The fleet being afterwards joined by Alcibiades, nine more of the Peloponnesian galleys were taken, the Halicarnassians were constrained to pay a large sum of money, and Cos was strongly fortified; which transactions ended the 21st year of the Peloponnesian war.

In the succeeding years of this famous war, the Athenians had at first great advantages. Thrasybulus gained a signal victory at sea; and Alcibiades gained two victories, one by sea and another by land, in one day, took the whole Peloponnesian fleet, and more spoil than his men could carry away. The Spartans were now humbled in their turn, and sued for peace; but the Athenians were so intoxicated with their success, that they sent back the ambassadors without an answer; which they soon had sufficient reason to repent of. The beginning of the Athenians misfortunes was the taking of Pylus by the Spartans. The Athenians had sent a fleet under the command of one Anytus to its defence: but he was driven back by contrary winds; upon which he was condemned to death, because he could not cause the wind blow from what quarter he pleased: this sentence, however, was remitted on his paying a vast sum of money. This misfortune was quickly followed by another. The Megarians surprised Nisaea; which enraged the Athenians so much, that they immediately sent an army into that country, who defeated the Megarians who opposed them, with great slaughter, and committed horrid devastations.

158 The Spartans sue for peace.

159 They take Pylus.

These misfortunes as yet, however, were overbalanced by the great actions of Alcibiades, Thrasybulus, and

Attica.

and Theramenes. When Alcibiades returned, he

160 Alcibiades enters Athens in triumph.

brought with him a fleet of 200 ſhips, and ſuch a load of ſpoils as had never been ſeen in Athens ſince the concluſion of the Perſian war. The people left their city deſtitute, that they might crowd to the port, to behold Alcibiades as he landed; old and young bleſſed him as he paſſed; and the next day when he made a harangue to the aſſembly, they directed the record of his baniſhment to be thrown into the ſea, abſolved him from the curſes he lay under, and created him general with full power. Nor did he ſeem inclined to indulge

161 He is diſgraced.

himſelf in eaſe, but ſoon put to ſea again with a fleet of 100 ſhips. He had not been long gone, however, before all this was forgot. Alcibiades ſailed to the Helleſpont with part of his fleet, leaving the reſt under the command of Antiochus his pilot, but with ſtrict orders to attempt nothing before his return. This command the pilot paid no regard to, but provoked Lyſander the Lacedemonian admiral to an engagement, and in conſequence of his temerity was defeated with the loſs of 15 ſhips, himſelf being killed in the engagement. On the news of this defeat Alcibiades returned, and endeavoured to provoke the Lacedemonians to a ſecond battle: but this Lyſander prudently declined; and in the mean time the Athenians, with unparalleled ingratitude and inconſtancy, deprived Alcibiades of his command, naming ten new generals in his room.

162 The Athenians gain a great victory and put ſix of their generals to death.

This was the laſt ſtep the Athenians had to take for perfecting their ruin. Conon, who ſucceeded to the command, was defeated by Callicratidas Lyſander's ſucceſſor; but being afterwards ſtrongly reinforced, the Lacedemonians were entirely defeated with the loſs of 77 ſhips. Such a victory might at this time have inſpired the Athenians with ſome kind of gratitude towards the generals who gained it: but inſtead of this, on pretence of their not having aſſiſted the wounded during the engagement, eight of them were recalled; two were wiſe enough not to return; and the ſix who truſted to the juſtice of their country were all put to death.

163 They are utterly defeated by Lyſander;

The next year Lyſander was appointed commander of what fleet the Peloponneſians had left, with which he took Thaſus and Lampſacus. Conon was diſpatched againſt him with 180 ſhips, which being greatly ſuperior to Lyſander's fleet, that general refuſed to come to an engagement, and was blocked up in the river Ægos. While the Athenians lay there, they grew quite idle and careleſs; inſomuch that Alcibiades, who had built a caſtle for himſelf in the neighbourhood, intreated them to be more on their guard, as he well knew Lyſander's abilities. They anſwered, that they wondered at his aſſurance, who was an exile and a vagabond, to come and give laws to them; telling him, that if he gave them any farther trouble, they would ſeize and ſend him to Athens. At the ſame time they looked on victory as ſo certain, that they conſulted what they ſhould do with their priſoners; which, by the advice of Philocles their general, was, to cut off all their right hands, or according to Plutarch, their right thumbs; and Adiamantus one of their officers rendered himſelf very obnoxious by ſaying, that ſuch idle diſcourſe did not become Athenians. The conſequences of ſuch conduct may be eaſily imagined. Lyſander fell unexpectedly upon them, and gained a moſt complete victory; Conon, with eight galleys only, eſcaping to Cyprus; after which Lyſander returned to Lampſacus, where he put to death Philocles with 3000 of his ſoldiers, and all the officers except Adiamantus. This execution being over, he reduced all the cities ſubject to Athens; and with great civility ſent home their garriſons, that ſo the city might be overſtocked with inhabitants, and deſtitute of proviſions, when he came to beſiege it; which he did ſoon after by ſea, while Agis with a great army inveſted it by land.

164 Who takes Athens.

For a long time the Athenians did not ſo much as deſire a peace; but at laſt were forced to ſend deputies to Agis, who ſent them to Sparta, where no terms could be granted except they conſented to demoliſh their walls. They next ſent to Lyſander, who after a long attendance referred them to Sparta; and thither Theramenes with ſome other deputies was immediately ſent. On their arrival, they found the council of the confederates ſitting, who all except the Spartans gave their votes that Athens ſhould be utterly deſtroyed; but they would not conſent to the ruin of that city,

165 Terms of peace.

which had deſerved ſo well of Greece. On the return of Theramenes, peace was concluded, on condition, that the long walls and the fortifications of the port ſhould be demoliſhed; that they ſhould give up all their ſhips but 12, receive all they had baniſhed, and follow the fortune of the Lacedemonians. Theſe ſevere terms were punctually executed. Lyſander cauſed the walls to be pulled down; all the muſic in his army playing, on that very day of the year on which they had beat the Perſians at Salamine. He likewiſe eſtabliſhed an oligarchy expreſsly againſt the will of the people; and thus the ruin of Athens ended the 27th year of the Peloponneſian war, and the 404th before Chriſt.

166 The thirty tyrants.

As ſoon as Lyſander had demoliſhed the long walls, and the fortifications of the Piræum, he conſtituted a council of thirty, with power, as was pretended, to make laws, but in truth to ſubjugate the ſtate. Theſe are the perſons ſo famous in hiſtory, under the title of *the thirty tyrants*. They were all the creatures of Lyſander; who, as they derived their riſe from conqueſt and the law of the ſword, exerciſed their offices in a ſuitable manner; that is, with the higheſt teſtimonies of pride, inſolence, and cruelty. Inſtead of making laws, they governed without them; appointed a ſenate and magiſtrates at their will; and, that they might do all things without danger of controul, they ſent for a garriſon from Lacedemon; which was accordingly granted them, under the command of Callidius, upon their promiſe to pay the ſoldiers regularly. One of the firſt ſteps they took was to puniſh all informers; which, though ſevere, was popular: but when, through flattery and bribes, they had wholly drawn over Callidius to their party, they ſuffered bad men to live in quiet, and turned their rage againſt the good.

167 Critias and Theramenes, their oppoſite characters.

Critias and Theramenes were at the head of the thirty, men of the greateſt power and abilities in Athens. The former was ambitious and cruel without meaſure; the latter was ſomewhat more merciful: the former puſhed on all the bloody ſchemes framed by his confederates, and carried into execution many of his own; the latter always oppoſed them, at firſt with moderation, at laſt with vehemence. He ſaid, that power was given them to rule, and not to ſpoil, the com-

Attica.

commonwealth; that it became them to act like shepherds, not like wolves; and that they ought to beware of rendering themselves at once odious and ridiculous, by attempting to domineer over all, being such a handful of men as they were. The rest, disliking much the former part of his discourse, catched hold of the latter, and immediately chose out 3000, whom they made the representatives of the people, and to whom they granted this notable privilege, that none of them should be put to death but by the judgment of the senate, thereby openly assuming a power of putting any other of the Athenian citizens to death by their own authority. A glorious use they made of this new-assumed privilege; for as many as they conjectured to be no friends to the government in general, or to any of themselves in particular, they put to death, without cause, and without mercy. Theramenes openly opposing this, and absolutely refusing to concur in such measures, Critias accused him to the senate as a man of unsteady principles, sometimes for the people, sometimes against them, always for new things and state-revolutions. Theramenes owned, that he had sometimes changed his measures, but alledged that he had always done it to serve the people. He said that it was solely with this view he made the peace with Sparta, and accepted the office of one of the thirty: that he had never opposed their measures while they cut off the wicked; but when they began to destroy men of fortune and family, then he owned he had differed with them, which he conceived to be no crime against the state.

168 Theramenes put to death.

While Theramenes was speaking, Critias withdrew, perceiving that the senate were thoroughly convinced of the truth of what Theramenes had said: but he quickly returned with a guard, crying out, that he had struck Theramenes's name out of the list of the 3000; that the senate had therefore no longer cognizance of the cause, which the thirty had already judged, and condemned him to death. Theramenes perceiving that they intended to seize him, fled to the altar, which was in the midst of the senate-house, and laying his hands thereon, said, "I do not seek refuge here because I expect to escape death or desire it; but that, tearing me from the altar, the impious authors of my murder may interest the gods in bringing them to speedy judgment, and thereby restore freedom to my country." The guards then dragged him from the altar, and carried him to the place of execution, where he drank the poison with undaunted courage, putting the people in mind with his last breath, that as they had struck his name out of the 3000, they might also strike out any of theirs. His death was followed by a train of murders, so that in a short time 60 of the worthiest and most eminent citizens of Athens fell by the cruelty of the thirty. Amongst these, the most pitied was Niceratus the son of Nicias; a man universally beloved for his goodness, and universally admired for his virtues. As for the Spartans, they, losing their former generosity, were extremely pleased with these things, and by a public decree commanded that such as fled from the thirty tyrants should be carried back bound to Athens: which extraordinary proceeding frightened all Greece; but the Argives and Thebans only had courage to oppose it: the former received the Athenian exiles with humanity and kindness; the latter punished with a mulct such of their citizens as did not rise and rescue the Athenian prisoners, who in pursuance of the Lacedemonian decree were carried bound through their territories.

Thrasybulus, and such as with him had taken shelter in the Theban territory, resolved to hazard every thing, rather than remain perpetual exiles from their country; and though he had but 30 men, on whom he could depend, yet considering the victories he had heretofore obtained in the cause of his country he made an irruption 169
into Attica, where he seized Phyla, a castle at a very small distance from Athens, where in a very short space his forces were augmented to 700 men; and though the tyrants made use of the Spartan garrison in their endeavours to reduce him and his party, yet Thrasybulus prevailed in various skirmishes, and at last obliged them to break up the blockade of Phyla, which they had formed. The thirty and their party conceiving it very advantageous for them to have the possession of Eleusina, marched thither, and having persuaded the people to go unarmed out of their city, that they might number them, took this opportunity most inhumanly to murder them. The forces of Thrasybulus increasing daily, he at length possessed himself of the Piræum, which he fortified in the best manner he could; but the tyrants being determined to drive him from thence, came down against him with the utmost force they could raise. Thrasybulus defended himself with great obstinacy; and in the end they were forced to retreat, having lost before the place not only a great 170
number of their men, but Critias the president of the thirty, another of the same body, and one who had been a captain of the Piræum.

Thrasybulus seizes Phyla.

Critias killed.

When they came to demand the dead from Thrasybulus, in order for their interment, he caused a crier he had with him to make a short speech in a very loud voice to the people, intreating them to consider, that as they were citizens of Athens without, so those against whom they fought, and those who fought to preserve themselves within the fort, were Athenian citizens also; wherefore, instead of thinking how to ruin and destroy their brethren, they ought rather to consult how all differences ought to be composed, and especially ought to rid themselves of those bloody tyrants, who, in the short time they had had the administration in their hands, had destroyed more than had fallen in the Peloponnesian war. The people, though moved by these discourses, differed among themselves; the consequence of 171
which was, that they expelled the thirty, and chose ten men out of each tribe to govern in their stead, whereupon the tyrants retired to Eleusina. The citizens, however, though they changed the government, made no agreement with those in the Piræum; but sent away deputies to Sparta, as did also the tyrants from Eleusina, complaining, that the Athenians had revolted, and desiring their assistance to reduce them. The Spartans 172
sent thereupon a large sum of money to encourage their confederates, and appointed Lysander commander in chief, and his brother to be admiral; resolving to send sea and land forces to reduce Athens a second time; intending, as most of the Greek states suspected, to add it now to their own dominions. It is very probable that this design of theirs would have taken effect, if Pausanias king of Sparta, envying Lysander, had not resolved to obstruct it. With this view, he procured another army to be raised against the Athenians,

The tyrants expelled.

Attempt of the Spartans to reduce Athens a second time.

nians, of which himſelf had the command, and with which he marched immediately to beſiege the Piræum. While he lay before the place, and pretended to attack it, he entered into a private correſpondence with Thraſybulus, informing him what propoſitions he ſhould make in order to force the Lacedemonians, who were ſuſpected by their allies, to grant them peace.

173 How fruſtrated.

The intrigues of Pauſanias had all the ſucceſs he could wiſh. The Ephori who were with him in the camp concurred in his meaſures, ſo that in a ſhort ſpace a treaty was concluded on the following terms: That all the citizens of Athens ſhould be reſtored to their houſes and privileges, excepting the thirty, the ten which had ſucceeded them and who had acted no leſs tyrannically than they, and the eleven who during the time of the oligarchy had been conſtituted governors or keepers of the Piræum; that all ſhould remain quiet for the future in the city; and that if any were afraid to truſt to this agreement, they ſhould have free leave to retire to Eleuſina. Pauſanias then marched away with the Spartan army, and Thraſybulus at the head of his forces marched into Athens, where, having laid down their arms, they ſacrificed with the reſt of the citizens in the temple of Minerva, after which the popular government was reſtored. Yet quiet was not thoroughly eſtabliſhed. The exiles at Eleuſina having endeavoured by the help of money to raiſe an army of foreigners, by whoſe aid they might recover the authority they had loſt: but firſt depending on their friends in the city, they ſent ſome of the principal perſons amongſt them as deputies, to treat with the citizens; but ſtrictly inſtructed them to ſow jealouſies and excite diſcords among them. This the latter quickly perceiving, put theſe perſons to death; and then remonſtrating to thoſe at Eleuſina, that theſe contentions would undoubtedly end either in their own or the deſtruction of their country, they offered immediately to paſs an act of oblivion, which they would confirm with an oath.

This being accepted, thoſe who had withdrawn returned to the city, where all differences were adjuſted, and both parties moſt religiouſly obſerved the agreement they had made, and thereby thoroughly reſettled the ſtate.

174 Virtue of Thraſybulus.

In this whole tranſaction, the virtue of Thraſybulus deſerves chiefly to be admired. When he firſt ſeized the caſtle of Phyla, the tyrants privately offered to receive him into their number inſtead of Theramenes, and to pardon at his requeſt any 12 perſons he ſhould name: but he generouſly anſwered, That his exile was far more honourable than any authority could be, purchaſed on ſuch terms; and by perſiſting in his deſign, accompliſhed, as we have ſeen, the deliverance of his country. A glorious deliverance it was; ſince, as Iſocrates informs us, they had put 1400 citizens to death contrary to and without any form of law, and driven 5000 more into baniſhment; procuring alſo the death of Alcibiades, as many think, tho' at a great diſtance from them.

From this time to the reign of Philip of Macedon, the Athenians continued in a pretty proſperous ſituation, though they never performed any ſuch great exploits as formerly. By that monarch and his ſon Alexander all Greece was in effect ſubdued; and the hiſtory of all the Grecian ſtates from that time becomes much leſs intereſting. Of the hiſtory of Athens from that time to the preſent, the following elegant abridgment is given by Dr Chandler†. "On the death of Alexander, the Athenians revolted, but were defeated by Antipater, who gariſoned Munychia. They rebelled again, but the garriſon and oligarchy were reinſtated. Demetrius the Phalerean, who was made governor, beautified the city, and they erected to him 360 ſtatues; which on his expulſion they demoliſhed, except one in the Acropolis. Demetrius Poliorcetes withdrew the garriſon, and reſtored the democracy; when they deified him, and lodged him in the Opiſthodomos or the back part of the Parthenon, as a gueſt to be entertained by their goddeſs Minerva. Afterwards they decreed, that the Piræus, with Munychia, ſhould be at his diſpoſal; and he took the Muſeum. They expelled his garriſon, and he was perſuaded by Craterus a philoſopher to leave them free. Antigonus Gonatas, the next king, maintained a garriſon in Athens: but, on the death of his ſon Demetrius, the people, with the aſſiſtance of Aratus, regained their liberty; and the Piræus, Munychia, Salamis, and Sunium, on paying a ſum of money.

† *Travels in Greece*, p. 28, &c.

175 Hiſtory of Athens from the time of Alexander the Great to the preſent.

"Philip, ſon of Demetrius, encamping near the city, deſtroying and burning the ſepulchres and temples in the villages, and laying their territory waſte, the Athenians were reduced to ſolicit protection from the Romans and to receive a garriſon, which remained until the war with Mithridates king of Pontus, when the tyrant Ariſtion made them revolt.

176 Athens beſieged and taken by Sylla.

"Archelaus the Athenian general, unable to withſtand the Roman fury, relinquiſhed the *long walls*, and retreated into the Piræus and Munychia. Sylla laid ſiege to the Piræus and to the city, in which Ariſtion commanded. He was informed that ſome perſons had been overheard talking in the Ceramicus, and blaming Ariſtion for his neglect of the avenues about the Heptachalcos, where the wall was acceſſible. Sylla reſolved to ſtorm there, and about midnight entered the town at the gate called *Dypylon* or *the Piræan*; having levelled all obſtacles in the way between it and the gate of the Piræus. Ariſtion fled to the Acropolis, but was compelled to ſurrender by the want of water; when he was dragged from the temple of Minerva, and put to death. Sylla burned the Piræus and Munychia, and defaced the city and ſuburbs not ſparing even the ſepulchres."

The civil war between Cæſar and Pompey ſoon followed, and their natural love of liberty made them ſide with Pompey. Here again they were unfortunate, for Cæſar conquered. But Cæſar did not treat them like Sylla, with that clemency which made ſo amiable a part of his character, he dimiſſed them by a fine alluſion to their illuſtrious anceſtors, ſaying, that he ſpared the living for the ſake of the dead.

Another ſtorm followed ſoon after this; the wars of Brutus and Caſſius with Auguſtus and Antony. Their partiality for liberty did not here forſake them: they took part in the conteſt with the two patriot Romans, and erected there ſtatues near their own ancient deliverers Harmodious and Ariſtogiton, who had ſlain Hipparchus. But they were ſtill unhappy, for their enemies triumphed.

"They next joined Antony, who gave them Ægina and Cea, with other iſlands. Auguſtus was unkind to them; and they revolted four years before he died. Under Tiberius the city was declining, but free, and regarded as an ally of the Romans. The high privi-

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"The emperor Vespasian reduced Achaia to a province paying tribute and governed by a proconsul. Nerva was more propitious to the Athenians; and Pliny, under Trajan his successor, exhorts Maximus to be mindful whether he was sent, to rule genuine Greece, a state composed of free cities. 'You will revere the gods and heroes their founders. You will respect their pristine glory, and even their age. You will honour them for the famous deeds, which are truly, nay for those which are fabulously recorded of them. Remember, it is Athens you approach.' This city was now entirely dependent on Rome, and was reduced to sell Delos and the islands in its possession.

"Hadrian, who was at once emperor and an archon of Athens, gave the city laws, compiled from Draco, Solon, and the codes of other legislators; and displayed his affection for it by unbounded liberality. Athens reflourished, and its beauty was renewed. Antoninus Pius who succeeded, and Antoninus the Philosopher, were both benefactors.

The barbarians of the north, in the reign of Valerian, besieging Thessalonica, all Greece was terrified, and the Athenians restored their city-wall, which had been dismantled by Sylla, and afterwards neglected.

"Under the next emperor, who was the archon Gallienus, Athens was besieged, the archontic office ceased; and the Strategus or general, who had before acted as overseer of the agora or market, then became the supreme magistrate. Under Claudius his successor, the city was taken, but soon recovered.

"It is related, that Constantine, when emperor, gloried in the title of *general of Athens*; and rejoiced exceedingly on obtaining from the people the honour of a statue with an inscription, which he acknowledged by a yearly gratuity of many bushels of grain. He conferred on the governor of Attica and Athens the title of *grand duke* μεγας δουξ. That office was at first annual, but afterwards hereditary. His son Constans bestowed several islands on the city, to supply it with corn.

"In the time of Theodosius the First, 380 years after Christ, the Goths laid waste Thessaly and Epirus; but Theodore, general of the Achæans, by his prudent conduct preserved the cities of Greece from pillage, and the inhabitants from being led into captivity. A statue of marble was erected to him at Athens by order of the city; and afterwards one of brass, by command of the emperor, as appears from an inscription in a church dedicated to a saint of the same name, not far from the French convent. It is on a round pedestal, which supports a flat stone serving for the holy table. Eudocia the wife of Theodosius the second was an Athenian.

177 By Alaric the Goth.

"The fatal period now approached, and Athens was about to experience a conqueror more savage even than Sylla. This was Alaric king of the Goths; who under the emperors Arcadius and Honorius, over-ran Greece and Italy, sacking, pillaging, and destroying. Then the Peloponnesian towns were overturned, Arcadia and Lacedemon were laid waste, the two seas by the Isthmus were burnished with the flames of Corinth, and the Athenian matrons were dragged in chains by barbarians. The invaluable treasures of antiquity, it is related, were removed; the stately and magnificent structures converted into piles of ruin; and Athens was stripped of every thing splendid or remarkable. Synesius a writer of that age, compares the city to a victim, of which the body had been consumed, and the hide only remained.

"After this event, Athens became an unimportant place, and as obscure as it once had been famous. We read that the cities of Hellas were put into a state of defence by Justinian, who repaired the walls, which at Corinth had been subverted by an earthquake, and at Athens and in Bœotia were impaired by age: and here we take a long farewel of this city. A chasm of near 700 years ensues in its history, except that, about the year 1130, it furnished Roger the first king of Sicily with a number of artificers, whom he settled at Palermo, where they introduced the culture of silk, which then passed into Italy. The worms had been brought from India into Constantinople in the reign of Justinian.

"Athens as it were, re-emerges from oblivion in the 13th century, under Baldwin, but besieged by a general of Theodorus Lascaris, the Greek emperor. It was taken in 1427 by Sultan Morat. Boniface, marquis of Montferrat, possessed it with a garrison; after whom it was governed by Delves, of the house of Arragon. On his death, it was seized, with Macedonia, Thessaly, Bœotia, Phocis, and the Peloponnesus, by Bajazet; and then, with the island Zante, by the Spaniards of Catalonia in the reign of the Greek emperor Andronicus Palæologus the elder. These were dispossessed by Reinerius Acciaioli, a Florentine; who, leaving no legitimate male issue, bequeathed it to the state of Venice. His natural son, Antony, to whom he had given Thebes with Bœotia, expelled the Venetians. He was succeeded in the dukedom by his kinsman Nerius, who was displaced by his own brother named *Antony*, but recovered the government when he died. Nerius leaving only an infant son, was succeeded by his wife. She 178
By the Turks.
was ejected by Mahomet on a complaint from Francus son of the second Antony, who confined her at Megara and made away with her; but her son accusing him to Mahomet the Second, the Turkish army under Omar advanced, and he surrendered the citadel in 1455; the Latins refusing to succour him unless the Athenians would embrace their religious tenets. Mahomet, it is related, when he had finished the war with the despot of the Morea, four years after, surveyed the city and Acropolis with admiration. The janizaries informed him of a conspiracy; and Francus Acciaioli, who remained lord of Bœotia, was put to death. In 1464 the Venetians landed at the Piræus, surprised the city, and carried off their plunder and captives to Eubœa.

"It is remarkable, that after these events Athens was again in a manner forgotten. So lately as about the middle of the 16th century, the city was commonly believed to have been utterly destroyed, and not to exist, except a few huts of poor fishermen. Crusius, a learned and inquisitive German, procured more authentic information from his Greek correspondents residing in Turky, which he published in 1584, to awaken curiosity and to promote farther discoveries. One of these letters is from a native of Nauplia, a town near Argos in

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in the Morea. This writer says, that he had been often at Athens, and that it still contained many things worthy to be seen, some of which he enumerates, and then subjoins: "But why do I dwell on this place? It is as the skin of an animal that has been long dead."

It now remains to give some idea of the character, government, and religion of this once so famous people.

179 Character of the ancient Athenians.

The Athenians, says Plutarch, are very subject to violent anger; but they are soon pacified. They are likewise easily impressed with humanity and compassion. That this was their temper, is proved by many historical examples. We shall produce a few. The sentence of death pronounced against the inhabitants of Mitylene, and revoked the next day: The condemnation of Socrates, and that of the ten chiefs, each followed by quick repentance and most pungent grief.

The minds of the same people adds Plutarch, are not formed for laborious researches. They seize a subject, as it were by intuition; they have not patience and phlegm enough to examine it gradually and minutely. This part of their character may seem surprising and incredible. Artisans, and and other people of their rank, are in general slow of comprehension. But the Athenians of every degree were endowed with an inconceivable vivacity, penetration, and delicacy of taste. Even the Athenian soldiers could repeat the fine passages of the tragedies of Euripides. Those artisans and those soldiers assisted at public debates, were bred to political affairs, and were equally acute in apprehension and in judgment. We may infer the understanding of the hearers of Demosthenes from the genius of his orations, which were laconic and poignant.

As their inclination, continues Plutarch, leads them to assist and support people of low condition, they like discourse seasoned with pleasantry, and productive of mirth. The Athenians patronize people of low degree; because from them their liberty is in no danger, and because such patronage tends to support a democratical constitution. They love pleasantry; which turn of mind proves that they are a humane social people, who have a taste for raillery and wit, and are not soured with that reserve which marks the despot or the slave.

They take pleasure in hearing themselves praised; but they can likewise patiently bear raillery and censure. We know with what art and success Aristophanes and Demosthenes applied their praise and their irony to the Athenian people. When the republic enjoyed peace, says the same Plutarch in another place, it encouraged the adulation of its orators: but when it had important affairs to discuss, when the state was in danger, it became serious; and preferred, to its eloquent sycophants, the honest orators who opposed its follies and its vices: such ingenious and bold patriots as a Pericles, a Phocion, and a Demosthenes.

The Athenians, continues Plutarch, often make their governors tremble, and show great humanity to their enemies. They were very attentive to the information and instruction of those citizens who were most eminent for their policy and eloquence; but they were on their guard against the superiority of their talents; they often checked their boldness, and repressed their exuberant reputation and glory. That this was their temper, we are convinced by the ostracism; which was established to restrain the ambition of those who had great talents and influence, and which spared neither the greatest nor the best men. The detestation of tyranny and tyrants, which was inherent in the Athenians, rendered them extremely jealous of their privileges, made them zealous and active in defence of their liberty, whenever they thought it was violated by men in power.

As to their enemies, they did not treat them with rigour. They did not abuse victory by a brutal inhumanity to the vanquished. The act of amnesty, which they passed after the usurpation of the 30 tyrants, proves that they could easily forgive injuries. It was this mildness, this humanity of disposition, which made the Athenians so attentive to the rules of politeness and decorum. In their war with Philip, having seized one of his couriers, they read all the letters he bore, except one from Olympias to her husband, which they sent back unopened. Such was their veneration of love and conjugal secrecy; those sacred rights, which no enmity, no hostility, warrants us to violate!

The views of conquest cherished by a small republic, were extensive and astonishing; but this people, so great so ambitious in their projects, were, in other respects, of a different character. In the expences of the table, in dress, in furniture, in houses, in short, in private life, they were frugal, simple, modest, poor; but sumptuous and magnificent whenever the honour of the state was concerned. Their conquests, their victories, their riches, their connections with the inhabitants of Asia Minor, never reduced them to luxury, to riot, to pomp, to profusion. Xenophon remarks, that a citizen was not distinguished from a slave by his dress. The wealthiest citizen, the most renowned general, was not ashamed, to go himself to market.

The taste of the Athenians, for all the arts and sciences, is well known. When they had delivered themselves from the tyranny of Pisistratus, and after this had defeated the vast efforts of the Persians, they may be considered as at the summit of their national glory. For more than half a century afterwards they maintained, without controul, the sovereignty of Greece; and that ascendant produced a security, which left their minds at ease, and gave them leisure to cultivate every thing liberal or elegant. It was then that Pericles adorned the city with temples, theatres, and other beautiful public buildings. Phidias, the great sculptor, was employed as his architect, who, when he had erected edifices, adorned them himself; and added statues and basso-relievo's, the admiration of every beholder. It was then that Polignotus and Myro painted; that Sophocles and Euripides wrote; and not long after, that they saw the divine Socrates.

Human affairs are, by nature, prone to change; and states, as well as individuals, are born to decay. Jealousy and ambition insensibly fomented wars, and success in these wars, as in others, was often various. The military strength of the Athenians was first impaired by the Lacedemonians; after that, it was again hu-

humiliated, under Epaminondas, by the Thebans: and last of all it was wholly crushed by the Macedonian, Philip.

Nor, when their political sovereignty was lost, did their love of literature and arts sink along with it. Just at the close of their golden days of empire flourished Xenophon and Plato, the disciples of Socrates, and from Plato descended that race of philosophers called the *Old Academy*. Aristotle, who was Plato's disciple, may be said, not to have invented a new philosophy, but rather to have tempered the sublime and rapturous mysteries of his master with method, order, and a stricter mode of reasoning. Zeno, who was himself also educated in the principles of Platonism, only differed from Plato in the comparative estimate of things, allowing nothing to be intrinsically good but virtue, nothing intrinsically bad but vice, and considering all other things to be in themselves indifferent. He too and Aristotle accurately cultivated logic, but in different ways; for Aristotle chiefly dwelt upon the simple syllogism; Zeno upon that which is derived out of it, the compound or hypothetic. Both too, as well as other philosophers, cultivated rhetoric along with logic; holding a knowledge in both to be requisite for those who think of addressing mankind with all the efficacy of persuasion. Zeno elegantly illustrated the force of these two powers by a simile, taken from the hand: the close power of logic he compared to the fist, or hand compreſt: the diffuse power of logic, to the palm, or hand open.

The new academy was founded by Arcesilas, and ably maintained by Carneades. From a mistaken imitation of the great parent of philosophy Socrates (particularly as he appears in the dialogues of Plato), because Socrates doubted some things, therefore Arcesilas and Carneades doubted all.—Epicurus drew from another source; Democritus had taught him atoms and a void: by the fortuitous concourse of atoms he fancied he could form a world; while by a feigned veneration he complimented away his gods, and totally denied their providential care, left the trouble of it should impair their uninterrupted state of bliss. Virtue he recommended, though not for the sake of virtue, but pleasure: pleasure, according to him, being our chief and sovereign good. See Aristotle, Epicurus, Plato, Socrates, &c.

We have already mentioned the alliance between philosophy and rhetoric. This cannot be thought wonderful, if rhetoric be the art by which men are persuaded, and if men cannot be persuaded without a knowledge of human nature: for what but philosophy can procure us this knowledge? It was for this reason the ablest Greek philosophers not only taught, but wrote also treatises upon rhetoric. They had a farther inducement, and that was the intrinsic beauty of their language as it was then spoken among the learned and polite. They would have been ashamed to have delivered philosophy, as it has been too often delivered since, in compositions as clumsy as the common dialect of the mere vulgar.

The same love of elegance, which made them attend to their style, made them attend even to the places where their philosophy was taught. Plato delivered his lectures in a place shaded with groves, on the banks of the river Ilissus; and which, as it once belonged to a person called *Academus*, was called after his name, the Academy. Aristotle chose another spot of a similar character, where there were trees and shade; a spot called the Lycæum. Zeno taught in a portico or colonnade, distinguished from other buildings of that sort (of which the Athenians had many) by the name, the *Variegated Portico*, the walls being decorated with various paintings of Polygnotus and Myro, two capital masters of that transcendent period. Epicurus addressed his hearers in those well known gardens, called, after his own name, *The gardens of Epicurus*.

These places of public institution were called among the Greeks by the name of *Gymnasia*; in which, whatever that word might have originally meant, were taught all those exercises, and all those arts, which tended to cultivate not only the body but the mind. As man was a being consisting of both, the Greeks could not consider that education as complete, in which both were not regarded, and both properly formed. Hence their Gymnasia, with reference to this double end, were adorned with two statues, those of Mercury and of Hercules, the corporeal accomplishments being patronised (as they supposed) by the god of strength, the mental accomplishments by the god of ingenuity.

It was for the cultivation of every liberal accomplishment that Athens was celebrated (as we have said) during many centuries, long after her political influence was lost and at an end.

She was the place of education, not only for Greeks but for Romans. It was hither that Horace was sent by his father; it was here that Cicero put his son Marcus under Cratippus, one of the ablest philosophers then belonging to that city.—The sects of philosophers, which we have already described, were still existing when St Paul came thither. We cannot enough admire the superior eloquence of that apostle, in his manner of addressing so intelligent an audience. We cannot enough admire the sublimity of his exordium; the propriety of his mentioning an altar which he had found there; and his quotation from Aratus, one of their well-known poets. Nor was Athens only celebrated for the residence of philosophers, and the institution of youth: men of rank and fortune found pleasure in a retreat, which contributed so much to their liberal enjoyment.

We shall finish this picture of the Athenians by the addition of one object more, to which every one will admit they have a right; an object which was prominent and striking, in all their actions and in all their enterprizes: we mean their ardent love of liberty. This was their predominant quality; the main spring of their government. From the beginning of the Persian war they sacrificed every thing to the liberty of Greece. They left, without hesitation, their cities, their houses, to fight at sea the common enemy, from whom they were in danger of servitude. What a glorious day was it for Athens, when all her allies, growing flexible to the advantageous offers which were made to them by the king of Persia, she replied by Aristides, to the ambassadors of that monarch,—"That it was impossible for all the gold in the world to tempt the republic of Athens: to prevail with her to sell her liberty, and that of Greece." It was by these generous senti-

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sentiments that the Athenians not only became the bulwark of Greece, but likewise guarded the rest of Europe from a Persian invasion.

These great qualities were blended with great failings, seemingly incompatible with Patriotism. For the Athenians, notwithstanding their tenacious jealousy of the rights of their country, were a volatile, inconstant capricious people.

180 Religion.

There never was a people more attentive to the worship of the gods than the Athenians. The worship of their principal deities was diffused over all Greece, and even beyond its limits.

Each temple had its particular religious rites: the pomp, the ceremonies, the duration, and the succession of the solemn feasts, were all appointed by fixed rules. The worship paid to each divinity, whether public or private, was founded on traditions, or on laws constantly obeyed. The feast of Bacchus, the Panathenæa, the feast of the mysteries of Eleusis, were celebrated according to established rules, most of which were as ancient as the feasts themselves. The old customs, of which the priests were the guardians, were observed in the temples. It is probable that the priests were consulted on affairs in which the worship of a deity was interested, and that their answer was decisive. We are certain that the Eumolpidæ had this authority. They were the interpreters of the ancient laws on which the worship of Ceres was founded, its magnificence, and its mode—laws which were not written, as Lysias informs us, but were perpetuated by a constant observation. The abuses which had gradually crept into the celebration of those feasts, had given rise to several new regulations; to that of the orator Lycurgus, for example, and to the law of Solon, which enjoined the senate to repair to Eleusis on the second day of the feast; but neither these nor the other particular regulations which we find in Samuel Petit's collection of Attic laws, could make a religious code. There was no general system which comprehended all the branches of their religion, which, by combining all its articles, might regulate their belief and conduct, and direct the judges in their decisions.

181 Crimes against religion why sometimes punished with severity.

Crimes against religion were only punished as they affected the state; and consequently they were tried by the magistrate. Mere raillery, though somewhat profane, was thought productive of no worse consequence than offending the ministers of the gods. The Athenians acknowledged no other religion than the hereditary public worship; no other gods than those they had received from their ancestors; no other ceremonies than those which had been established by the laws of the state, and practised by their country from time immemorial. They were only solicitous to preserve this worship, which was closely interwoven with their government, and made a part of its policy. They were likewise attentive to the ceremonial pomp; because order, the regular vigour of legislation, depends greatly on the awe impressed by externals. But as to the inconsistent and monstrous romance of fables, foreign opinions, popular traditions, and poetical fictions, which formed a religion quite different from that of the state —in it they were very little interested, and allowed every one to think of it as he pleased.

This explanation will reconcile a seeming contradiction in the conduct of the Athenians, who gave great licence to their poets, and severely punished the citizens who were guilty of impiety. Aristophanes, who made as free with the gods as with the great, was applauded by the Athenians. They condemned Socrates to death, who revered the deity, but disapproved the public manner of worshipping him. The life of Æschylus was in danger from a suspicion that he had revealed some of the secrets of Eleusis in one of his pieces. The wit of Aristophanes's drama was unpunished.

182 Priests their duty.

The priests were not confined to the care of the altars; they who were vested with the sacerdotal dignity, which was only incompatible with professions merely useful and lucrative, might likewise hold the most important offices of the commonwealth. This we could prove by a great number of examples; we shall cite that of Xenophon the illustrious historian and philosopher: he was likewise a famous general, and he was a priest. He was performing the sacerdotal function when he received the news of his son's death, who was killed at the battle of Mantinea.

The sacred ministry was not only compatible with civil offices, but likewise with the profession of arms. The priest and the soldier were often blended. Callias, the priest of Ceres, fought at Platæa. This custom was not peculiar to the Athenians. The Lacedemonians, after the battle which we have just mentioned, made three graves for their slain; one for the priests, one for the other Spartans, and one for the Helots.

183 Sacred revenues, &c.

As every mean employment was incompatible with the sacerdotal dignity, the priests had a revenue fixed to their office. We know that a part of the victims was their right, and that apartments were assigned them near the temples. But, beside these advantages, they had a salary proportioned to the dignity of their functions and to the rank of the deities whom they served. Their salary was probably paid from the revenue of the temples. Those revenues, which kept the temples in repair, and defrayed the sacrificial expences, were very considerable. They were of many different kinds.

A great part of the sacred revenues arose from fines, which individuals were condemned to pay for various offences; fines, of which the tenth part was appropriated to Minerva Polias, and the fiftieth to the other gods and to the heroes whose names their tribes bore. Besides, if the Prytanes did not hold the assemblies conformably with the laws, they were obliged to pay a fine of 1000 drachms to the goddess. If the Proedri, *i. e.* the senators whose office it was to lay before the assembly the matters on which they were to deliberate, did not discharge that duty according to the rules prescribed to them, they were likewise condemned to pay a fine, which, as the former, was applied to the use of Minerva. By these fines her temple must have been greatly enriched.

Besides this revenue, which was the common property of the gods, and which varied according to the number and degrees of the misdemeanors, the temples had their permanent revenues: We mean the produce of the lands which were consecrated to the deities. We do not here allude to the lands consecrated to the gods, which were never to be cultivated; such as the territory of Cirrha, proscribed by a solemn decree of the

Attica. the Amphictyons; the land betwixt Megara and Attica, which was consecrated to the goddesses of Eleusis, and many others. We would speak only of those which were cultivated, the fruits of which enriched the temples.

There were likewise lands belonging to the state, the produce of which was destined to defray the expence of the sacrifices which were offered in the name of the republic. There were likewise first-fruits which the public officers levied on all lands, for the use of the gods. All these emoluments made a part of the revenue of the temples.

The gods, besides the revenues immediately appertaining to their temples, had certain rights which were granted them by particular compact. The Lepreatæ, for instance, were obliged to pay every year a talent to Olympian Jupiter, on account of a treaty of alliance which they made with the Eleans in one of their wars. The inhabitants of Epidaurus, to obtain leave from the Athenians to cut down olive-trees for statues, which the Pythian priestess had commanded them to make, engaged to send deputies every year to Athens, to offer sacrifices in their name to Minerva and to Neptune. But this prerogative was rather honorary than lucrative.

The tenth part of the spoils taken in war was likewise the property of Minerva. Sacred vessels were bought with the effects of the 30 tyrants. In short, the gods were profited by almost every public accident. But what contributed most to enrich the famous temples of Greece, was the money which was constantly brought to them by individuals, in consequence of vows they had made, or to pay for sacrifices which were offered in their names. The credulity of the people was an inexhaustible fund. That credulity enriched the temples of Deli and Eleusis, and supported the magnificence of Delphi. And those immense treasures which were the fruit of superstition, were often a prey to avarice.

These revenues were not deposited with the priests; nor did they expend them. A moderate salary was all their gain; and to offer sacrifices to the deities whose ministers they were, was all their employment.

It is very probable that all the sacred revenues were paid into the hands of officers who were appointed to receive them, and who were to give an account of the discharge of their trust. Nay, we cannot doubt of this, after reading a passage in Aristotle, who, speaking of the officers of the temples, expresly mentions those who were entrusted with the money appertaining to the gods. Citizens, without doubt, of approved integrity, were chosen to this office; and their duty must have been, to keep the temples in repair and order, and to disburse and keep an account of the ordinary sacred expences.

As to the solemn feasts, which were incredibly magnificent, such as the feast of Bacchus, and the Panathenæa, they were celebrated at the expence of the Chorègus; *i. e.* of the chief of the choir of each tribe: for each tribe had its poet and its musicians, who sung, emulating each other, hymns in honour of the deity. The richest citizens were appointed chiefs of the different choirs; and as their office was very expensive, to indemnify them in some degree, the Chorègus of the victorious tribe had the privilege of engraving his name on the tripod which that tribe suspended to the roof of the temple. This office, though ruinous, was eagerly solicited; and naturally, in a republican state. It led to honours, like the Curule dignity at Rome; and it greatly tended to ingratiate its possessor with a people, who were more affected with pleasures than with essential services, and who, consequently, would more highly esteem a profuse Chorègus than a victorious general.

With regard to the fines, which were in the whole, or in part, the property of Minerva and of the other deities, there were at Athens public treasurers appointed to receive them. They were ten in number, and they were nominated by lot. They were called *Treasurers of the Goddess*, or *Receivers of the sacred money*. That money they received in the presence of the senate; and they were empowered to diminish or to annihilate the fine, if they thought it unjust. The statue of Minerva, that of the victories, and the other invaluable pledges of the duration of the state, were deposited with them.

The treasury in which the money consecrated to the gods was kept, was in the citadel, behind the temple of Minerva Polias; and from its situation it was termed *Opistodomus*. It was surrounded with a double wall. It had but one door, the key of which was kept by the Epistates, or chief of the Prytanes: his dignity was very considerable; but it lasted only one day. In this treasury a register was kept, in which were written the names of all those who were indebted to the state: he who owed the smallest fine was not omitted. If the debtors proved insolvent, they were prosecuted with extreme rigour, and often punished with a cruelty which religion could not excuse; though the interest of the gods was the motive, or rather the pretext. The sacred treasurers held a considerable rank among the magistrates, who received the public finances. Of these magistrates there were many kinds, as there were many sorts of revenues.

The Athenian priests did not compose an order distinct and separate from the other orders of the state. They did not form a body united by particular laws, under a chief whose authority extended to all his inferiors. The dignity of sovereign pontiff was unknown at Athens; and each of the priests served his particular temple, connected with his brethren. The temples, indeed, of the principal deities; those of Minerva, for instance, of Neptune, of Ceres, and of Proserpine, had many ministers; and in each of them a chief presided, who had the title of *High-Priest*. The number of subaltern ministers was in proportion to the rank of the deity; but the priests of one temple were altogether a separate society from those of another. Thus at Athens there was a great number of high priests, because many deities were worshipped there, whose service required many ministers. The power of each priest was confined to his temple; and there was no sovereign pontiff, the minister general of the gods, and the president at all the feasts.

It naturally follows from this account, that the ministers of the gods at Athens were not judges in matters of religion. They were neither authorised to take cognisance of crimes committed against the deity, nor to punish them. Their function was to offer sacrifices to the gods, and to intreat their acceptance of the ado-

Attica. adorations of the people. But the punishment of impiety, of sacrilege, of the profanation of mysteries, and of other irreligious crimes, was not entrusted to their zeal.

The priests were not only incapable of avenging crimes against religion by a temporal process; they even could not, without an express order either from the senate or the people, exercise their right of devoting criminals to the infernal gods. It was in consequence of a civil sentence pronounced against Alcibiades, that the Eumolpidæ launched their anathema against him. It was in virtue of another decree that they revoked their imprecations, when his countrymen wanted his service, and therefore restored him to their favour.

Religious causes, according to M. de Bougainville, fell under the jurisdiction of the Heliastæ.

The government, though often altered, continued pretty much on the plan established by Solon.

184
People divided into different tribes, &c.

The people of Athens were freemen, sojourners, or slaves. The citizens, called in Greek *Politai*, were very numerous; but what may seem strange, were as many in the time of Cecrops as in the most flourishing state of the commonwealth, hardly ever exceeding 20,000. It was Solon who decreed that none should be accounted free but such as were Athenians both by father and mother. After his time it fell into desuetude, till revived by Pericles, and again at his instance repealed. After the expulsion of the 30 tyrants, Solon's law was restored. A person born of a stranger was styled *Nothos*, a bastard; whereas the son of a free woman was called *Cnesios*, i. e. *legitimate*. There was in Cynosarges a court of judicature, to which causes of illegitimacy properly belonged; and the utmost care was taken to prevent any from being inrolled Athenian citizens, who had not a clear title thereto. The citizens were divided by Cecrops into four tribes: the first called *Cecropes*, from Cecrops; the second, *Autochthon*, from a king of that name; the third, *Actai*, from Acteus another king of Athens, or rather from *Acte*, which signifies a *shore*: the fourth, *Pluralia*: these names were altered by Cranaus, and again by Ericthonius. In the reign of Ericthеus, they were again changed: the soldiers were called *Oplitai*, the craftsmen *Ergatai*, the farmers *Georgoi*, the graziers and shepherds *Aigicorai*: in this state they were when Solon settled the commonwealth, and appointed the senate to be composed of 400, 100 out of each tribe. Clysthenes increased the number of the tribes to 10; and made the senate consist of 500, taking 50 out of each tribe. In succeeding times, two other tribes were added. Each tribe was subdivided into its *Demoi* or wards; and with respect to these it was that Solon instituted the public feasts beforementioned, at which sometimes the whole tribe assembled, sometimes several wards, and sometimes only the inhabitants of one ward.

The second sort of inhabitants we mentioned were called *Metoicoi*, i. e. *sojourners*; these were persons who lived always at Athens, yet were not admitted free denizens; as for such as did not constantly reside in Athens, they were styled *Xenoi*; i. e. *strangers*. The sojourners were obliged to choose out of the citizens protectors, who were styled *Patrons*: they paid services to the state, and besides these an annual tribute of 12 drachms for every man, and six for every woman; but such as had sons, and paid for them, were exempted. If people fell to poverty, and were not able to pay the tribute, they were seized by the taxmasters, and actually sold for slaves: which, as Diogenes Laertius tells us, was the fate of Xenocrates the philosopher. The sojourners in Attica were under the same law as those in Athens. As to servants, they were freemen, who through indigency were driven to receive wages, and while they were in this state had no vote in the assembly. As to slaves, they were absolutely the property of their masters, and as such were used as they thought fit: They were forbidden to wear clothes, or to cut their hair like their masters; and which is indeed amazing, Solon prohibited them to love boys, as if that had been honourable: They were likewise debarred from anointing or perfuming themselves, and from worshipping certain deities: They were not allowed to be called by honourable names; and in most other respects were used like dogs. They stigmatized them at their pleasure, that is, branded them with letters in the forehead and elsewhere. However, Theseus's temple was allowed them as a sanctuary, whither, if they were exceedingly ill used, they might fly, and thereby oblige their owners to let them be transferred to another master. In this and many other respects the Athenian slaves were in a much better condition than those throughout the rest of Greece: they were permitted to get estates for themselves, giving a small premium to their masters, who were obliged to make them free if they could pay their ransom; they likewise obtained the same favour from the kindness of their masters, or for having rendered military services to the state. When they were made free, they were obliged to choose patrons; and had likewise the privilege of choosing a curator, who, in case their patrons injured them, was bound to defend them.

185
General assembly of the people.

The general assembly of the people, which Solon made the dernier resort, was called the *Ecclesia*; and consisted of all the freemen of Athens, excepting such as were *atimoi* or infamous. The meetings of these assemblies were either ordinary or extraordinary. The ordinary were such as were appointed by law, the extraordinary such as necessity required. Of the first there were four in 35 days. In the first assembly they approved or rejected magistrates, heard proposals for the public good, and certain causes. In the second they received petitions, and heard every man's judgement on the matters that were before them. In the third they gave audience to foreign ambassadors. The fourth was employed altogether in affairs relating to the gods and their worship. The extraordinary meetings were appointed by the magistrates when occasion required, whereas to the ordinary assemblies the people came of their own accord. The first were held either in the market-place, in the Pnyx, a place near the citadel, or in the theatre of Bacchus; as to the latter, the magistrates who appointed the extraordinary meeting appointed also the place where they should be held. If any sudden tempest arose, or any earthquake happened, or any sign notoriously inauspicious appeared, the assembly was immediately adjourned, to prevent the people from apprehending unhappy consequences from their deliberations. But if the weather was fair and serene, and nothing happened out of the ordinary course of things, they proceeded to purify the place where the

the assembly was held, which was done by sprinkling it round with the blood of young pigs: then the crier made a solemn prayer for the prosperity of the republic, and that heaven would bestow a happy issue on their counsels and undertakings; he then pronounced a bitter execration against any who should in that assembly propound what might be disadvantageous to the state. These ceremonies being over, they proceeded to business.

186 Method of giving their opinions.

There were several magistrates who had the overseeing and regulating these assemblies. These were, first, the Epistate, or president of the assembly, who was chosen by lot out of the Proedri: his office was to give the signal for the people's voting. Next to him were the Prytanes, *i. e.* a committee of the senate, who of course were present on this occasion: by their order a programma, or scheme of the business to be proposed at the assembly, was previously set up in some public place, that every man might know what business to apply his thoughts to. The Proedri were nine in number, appointed by lots out of all the tribes to which the Prytanes did not belong: they had the right of proposing to the people what they were to deliberate upon, and their office ended with the assembly; there sat with them assessors, who were to take care that nothing they proposed was detrimental to the commonwealth. The first step to business was the crier's reading the decree of the senate whereon the assembly was to deliberate; when he had finished this, he made proclamation in these words: *Who of the men above 50 will make an oration?* When the old men had done speaking, the crier made proclamation again that any Athenian might then offer his sentiments, whom the law allowed so to do; that is, all such as were above 30 years old, and were not infamous. If such a one rose up to speak, the Prytanes interposed, and bid him be silent; and if he did not obey them, the lictors pulled him down by force. When the debates were over, the president permitted the people to vote; which they did by casting first beans, but in after-times pebbles, into certain vessels: these were counted, and then it was declared that the decree of the senate was either rejected or approved: after which, the Prytanes dismissed the assembly.

187 The senate.

The senate was instituted by Solon to prevent the dangerous consequences of leaving the supreme power in the people. At the time of his institution, it was to consist of 400, 100 out of each tribe; it was increased to 500, when the tribes were augmented to 10; and when they came to 12, it was also swelled to 600. They were elected by lots after this manner: At a day appointed, towards the close of the year, the president of each tribe gave in a list of such persons belonging thereto, as were fit for and desired to appear for this dignity: these names were engraven on tablets of brass, and a number of beans equal to the number of the amount of them, among which were 100 white ones, put into a vessel; and then the names of the candidates and the beans were drawn one by one, and such as were drawn by the white beans were received into the senate. After the senate was elected, they proceeded to appoint the officers who were to preside in the senate: these were the Prytanes beforementioned, and they were elected thus: The names of the ten tribes were thrown into one vessel, and nine black beans and a white one into another vessel. Then the names of the tribes were drawn with the beans. The tribe to which the white bean answered, presided first; and the rest according to the order in which they were drawn.

188 Prytanes.

The Prytanes, while the senate consisted of 500, were 50 in number. For the farther avoiding of confusion therefore, 10 of these presided a week, during which space they were called *Proedri;* and out of these an Epistate or president was chosen, whose office lasted but one day, and by law no man could hold it more than once: the reason of this was, that he had in his custody the public seal, the keys of the citadel, and the charge of the exchequer. The reader must distinguish between the Epistates and Proedri last-mentioned, and those spoken of in the former paragraph, because, though their titles were the same, their office were perfectly distinct. The senate assembled by direction of the Prytanes once every day, excepting festivals, and sometimes oftner in the senate-house, which was thence called *Prytaneum.*

189 Laws how established, &c.

When a member of the senate made a motion for a new law, it was immediately engraven on tablets, that the members when they came next might be prepared to speak to it. At the subsequent assembly the Epistates opened the matter, after which every senator that pleased delivered his sentiments; then any of the Prytanes drew up the decree, and repeated it aloud: after which they proceeded to vote, and if there was a majority of white beans, then it became *psephisma,* and was afterwards propounded to the people: if they approved it, it became a law; otherwise it was of no force longer than the senate who decreed it subsisted. The power of the senate was very great: for they took the account of magistrates at the expiration of their offices; they directed the provisions made for poor citizens out of the public treasure; they had the superintendancy of public prisons, and a power of punishing such as committed acts morally evil, though not prohibited by any law; they had the care likewise of the fleet; and besides all these they had many other branches of authority, which it is not necessary for us to mention. Before they took their seats, they were constrained to undergo a very strict examination, wherein the whole course of their lives was inquired into; and if the least slur on their reputation appeared, they were set aside. When this examination was over, they took an oath, whereby they bound themselves to promote in all their councils the public good, to advise nothing contrary to the laws, and to execute their functions exactly. The highest fine the senate could impose was 500 drachms: if they thought the offender deserved a heavier mulct, they then transmitted the cause to the Thesmothetæ, who punished them as they thought fit. The senators, when their year was out, gave an account of their management to the people: but that they might have the less to do, they always punished such of their number as they found had offended, by expulsion; and in this they were mighty exact. Yet an expelled senator was notwithstanding eligible to any other office, the most trivial omission being sufficient to occasion a dismission from the senatorial dignity; and therefore, when the tribes chose their senators, they also chose a certain number of subsidiaries, out of which, when a senator was expelled, another was substituted in his place. Each senator was allowed a drachm every day: for it was a constant rule with the Athenians, that the public ought

ought to pay for every man's time; and therefore such of the poor Athenians as thought fit to demand it, had three oboli for going to the assembly. If during their administration any ships of war were built, the senators had crowns decreed them; but if not, they were forbid to sue for them.

Next to the senate was the court of AREOPAGUS,
200 for a description of which see that article.

Archons, Nomophylaces, &c.

The chief magistrates of Athens were Archons, and inferior to them there were many others; of whom it will be necessary to mention some. In the first place they had Nomophylaces, who were also styled *the eleven*, because they were so many in number, one chosen out of each tribe, and a clerk or secretary who made up the eleventh. Their duty it was to look to the execution of the laws: they had authority to seize robbers and other capital offenders; and if they confessed, to put them to death. Dr Potter thinks they resembled our sheriffs. The Phylarchi were the presidents of the Athenian tribes; but in time this became a military title. The Philobasileus was an officer in each tribe, who did the same things within his jurisdiction as the Basileus did with respect to the state. The Demarchi were the principal magistrates in wards. The Lexarchi were six in number, and were bound to take care that the people came duly to the assemblies; in their custody was the public register of the citizens names. They had under them Toxotæ, who were lictors or bailiffs; they were sometimes 1000 in number: these men were necessary: but, like most of their sort, were in a manner infamous, as may be gathered from the comedies of Aristophanes; they were generally Scythians, raw-boned, brawny fellows, ready to execute any thing they were commanded. The Nomothetæ were 1000 in number; their business was to watch over and inspect into the laws. There were two sorts of orators in the service of the state, some were appointed to defend an old law, when a motion was made to repeal it; these had their fee from the state, but the same man was incapable of being elected twice. Besides these, there were 10 settled orators called *Rhetores*, elected by lot; their business was to plead public causes in the senate-house.
201 For this they had their stated fees; and with respect to

Laws regarding orators.

their qualifications, the law run thus: "Let no one be a public orator who hath struck his parents, denied them maintenance, or shut them out of his doors; who hath refused to serve in the army; who hath thrown away his shield; who hath been addicted to lewd women, notoriously effeminate, or who has run out his patrimony. If any man who has been guilty of these crimes dare to deliver an oration, let him be brought to trial upon the spot. Let an orator have children lawfully begotten, and an estate within Attica; if in his oration he talks impertinently, makes idle repetitions, affects an unbecoming raillery, digresses from the point in question, or after the assembly is over, abuses the president, let the Proedri fine him 50 drachms; and if that is not thought enough, let him be brought before
202 the next assembly and fined again."

Courts of justice.

We shall conclude this draught of the Athenian government with an account of their courts of justice, which, exclusive of the Areopagus, were 10 in number; four had cognisance of criminal, and six of civil causes. These 10 courts were numbered with the 10 first letters of the alphabet, and were thence styled, *Alpha*, *Beta*, *Gamma*, &c. When an Athenian was at leisure to hear causes, he wrote his own name, that of his father, and the ward to which he belonged, upon a tablet; this he presented to the Thesmothetæ, who returned it again to him with another tablet, with the letter which fell to his lot; then he went to the crier of the court, who presented him a sceptre, and gave him admission. When the causes were over, every judge went and delivered his sceptre to the Prytanes, and received a stated fee for every cause that was tried. But as this was intended only to compensate their loss of time, so that there might be no appearance of covetousness, a man was forbid to sit in two courts on the same day. The first criminal court after the Areopagus, was that of the *Ephetæ*. It consisted of 51 members, all upwards of 51 years old. Draco gave it a very extensive jurisdiction; but Solon took away from them the power of judging in any other causes than those of manslaughter, accidental killing, and lying in wait to destroy: the Basileus entered all causes in this court. The second criminal court was called *Delphinium*, because it was held in the temple of Apollo Delphinius; it had cognisance of such murders as were confessed by the criminal, but at the same time justified under some pretence or other. The *Prytaneum* was the third criminal court. It held plea of such cases where death ensued from inanimate things: causes were heard here with the same solemnity as in other courts; and on judgment given, the thing, or whatever it was, that had occasioned the death of a man, was thrown out of the territory of Athens. The last criminal court was styled *Phreatum*. It sat in a place not far from the sea-shore; and such persons were brought before this court as had committed murders in their own country and fled to Attica: the proceedings of this court were so severe that they did not permit the criminal to come on shore, but obliged him to plead his cause in his vessel; and if he was found guilty, he was committed to the mercy of the wind and seas.

Of the judicatures for hearing civil causes, the first was the *Parabaston*, so called, as some think, because in it no matter could be heard if the cause of action was above one drachm. The *Cainon*, or new court, was the second tribunal. The third was styled the *court of Lycus*, because it assembled in a temple dedicated to that hero, whose statue, represented with the face of a wolf, was set up in all courts of justice. The *Trigonon* was so called, because it was triangular in its form. The court of *Metidius* derived its appellation from the architect who built it. The sixth and last court was called *Heliæa*; it was by far the greatest, and is generally conceived to have derived its name from the judges sitting in the open air exposed to the sun. All the Athenians who were free citizens were allowed by law to sit in these courts as judges; but before they took their seats were sworn by Apollo Patrius, Ceres, and Jupiter the king, that they would decide all things righteously and according to law, where there was any law to guide them; and by the rules of natural equity, where there was none. The Helæastic court consisted at least of 50, but its usual number was 500, judges: when causes of very great consequence were to be tried, 1000 sat therein, and now and then the judges were increased to 1500, and even to 2000. There were many inferior courts in Athens for the decision of tri-

Atticus, Attila.

vial causes; but of these there is no necessity of speaking, since we design no more than a succinct view of the Athenian republic, as it was settled by and in consequence of Solon's laws.

ATTICUS (Titus Pomponius), one of the most honourable men of ancient Rome. He understood the art of managing himself with such address, that, without leaving his state of neutrality, he preserved the esteem and affection of all parties. His strict friendship with Cicero did not hinder him from having great intimacy with Hortensius. The contests at Rome between Cinna's party and that of Marius induced him to go to Athens, where he continued for a long time. He was very fond of polite learning, and kept at his house several librarians and readers. He might have obtained the most considerable posts in the government; but chose rather not to meddle, because in the corruption and faction which then prevailed he could not discharge them according to the laws. He wrote Annals. He married his daughter to Agrippa; and attained to the age of 77.

ATTILA, king of the Huns, surnamed *the scourge of God*, lived in the 5th century. He may be ranked among the greatest conquerors, since there was scarcely any province in Europe which did not feel the weight of his victorious arms.

Gibbons's Rome, vol. iii. p. 357.

Attila deduced his noble, perhaps his regal, descent from the ancient Huns, who had formerly contended with the monarchs of China. His features, according to the observation of a Gothic historian, bore the stamp of his national origin; and the portrait of Attila exhibits the genuine deformity of a modern Caulmuck; a large head, a swarthy complexion, small deep-seated eyes, a flat nose, a few hairs in the place of a beard, broad shoulders, and a short square body, of nervous strength, though of a disproportioned form. The haughty step and demeanour of the king of the Huns expressed the consciousness of his superiority above the rest of mankind; and he had a custom of fiercely rolling his eyes, as if he wished to enjoy the terror which he inspired. Yet this savage hero was not inaccessible to pity; his suppliant enemies might confide in the assurance of peace or pardon; and Attila was considered by his subjects as a just and indulgent master. He delighted in war: but, after he had ascended the throne in a mature age, his head, rather than his hand atchieved the conquest of the north; and the fame of an adventurous soldier was usefully exchanged for that of a prudent and successful general. The effects of personal valour are so inconsiderable, except in poetry or romance, that victory, even among barbarians, must depend on the degree of skill, with which the passions of the multitude are combined and guided for the service of a single man. The Arts of Attila were skilfully adapted to the character of his age and country. It was natural enough, that the Scythians should adore, with peculiar devotion, the god of war; but as they were incapable of forming either an abstract idea, or a corporeal representation, they worshipped their tutelar deity under the symbol of an iron scimitar. One of the shepherds of the Huns perceived, that a heifer, who was grazing, had wounded herself in the foot; and curiously followed the track of the blood, till he discovered, among the long grass the point of an ancient sword; which he dug out of the ground, and presented to Attila. That magnanimous, or rather that artful prince, accepted with pious gratitude this celestial favour; and, as the rightful possessor of the *sword of Mars*, asserted his divine and indefeasible claim to the dominion of the earth. If the rites of Scythia were practised on this solemn occasion, a lofty altar, or rather pile of faggots, 300 yards in length and in breadth, was raised in a spacious plain; and the sword of Mars was placed erect on the summit of this rustic altar, which was annually consecrated by the blood of sheep, horses, and of the hundredth captive. Whether human sacrifices formed any part of the worship of Attila, or whether he propitiated the god of war with the victims which he continually offered in the field of battle, the favourite of Mars soon acquired a sacred character, which rendered his conquests more easy and more permanent; and the barbarian princes confessed, in the language of devotion or flattery, that they could not presume to gaze with a steady eye on the divine majesty of the king of the Huns. His brother Bleda, who reigned over a considerable part of the nation, was compelled to resign his sceptre and his life. Yet even this cruel act was attributed to a supernatural impulse; and the vigour with which Attila wielded the sword of Mars, convinced the world that it had been reserved alone for his invincible arm. But the extent of his empire affords the only remaining evidence of the number and importance of his victories; and the Scythian monarch, however ignorant of the value of science and philosophy, might perhaps lament that his illiterate subjects were destitute of the art which could perpetuate the memory of his exploits.

Attila.

If a line of separation were drawn between the civilized and the savage climates of the globe; between the inhabitants of cities who cultivated the earth, and the hunters and shepherds who dwelt in tents; Attila might aspire to the title of supreme and sole monarch of the Barbarians. He alone, among the conquerors of ancient and modern times, united the two mighty kingdoms of Germany and Scythia; and those vague appellations, when they are applied to his reign, may be understood with an extensive latitude. Thuringia, which stretched beyond its actual limits as far as the Danube, was in the number of his provinces: he interposed, with the weight of a powerful neighbour, in the domestic affairs of the Franks; and one of his lieutenants chastised, and almost exterminated, the Burgundians of the Rhine. He subdued the islands of the ocean, the kingdoms of Scandinavia, encompassed and divided by the waters of the Baltic; and the Huns might derive a tribute of furs from that northern region, which has been protected from all other conquerors by the severity of the climate, and the courage of the natives. Towards the east, it is difficult to circumscribe the dominion of Attila over the Scythian deserts: yet we may be assured, that he reigned on the banks of the Volga, that the king of the Huns was dreaded, not only as a warrior, but as a magician; that he insulted and vanquished the Khan of the formidable Geougen: and that he sent ambassadors to negociate an equal alliance with the empire of China. In the proud review of the nations who acknowledged the sovereignty of Attila, and who never entertained during his lifetime the thought of a revolt, the Gepidæ and the Ostrogoths

were

were distinguished by their numbers, their bravery, and the personal merit of their chiefs. The renowned Ardaric king of the Gepidæ, was the faithful and sagacious councellor of the monarch; who esteemed his intrepid genius, whilst he loved the mild and discreet virtues of the noble Walamir king of the Ostrogoths. The crowd of vulgar kings, the leaders of so many martial tribes, who served under the standard of Attila, were ranged in the submissive order of guards and domestics round the person of their master. They watched his nod; they trembled at his frown; and at the first signal of his will, they executed without murmur or hesitation his stern and absolute commands. In time of peace, the dependent princes, with their national troops, attended the royal camp in regular succession; but when Attila collected his military force, he was able to bring into the field an army of five, or, according to another account, of seven hundred thousand Barbarians.

For an account of his exploits and death, see the article HUNS.

ATTIRE, in hunting, signifies the head or horns of a deer. The attire of a stag, if perfect, consists of bur, pearls, beams, gutters, antler, sur-antler, royal, sur-royal, and crotches; of a buck, of the bur, beam, brow-antler, advancer, palm, and spellers.

ATTITUDE, in painting and sculpture, the gesture of a figure or statue; or it is such a disposition of their parts as serves to express the action and sentiments of the person represented.

ATTIUM, (anc. geog.) a promontory on the north-west of Corsica, (Ptolemy). It still retains some traces of its ancient name, being now called *Punta di Acciuolo* (Cluverius).

ATTLEBURY, a town in the county of Norfolk in England. E. Long. 0. 40. N. Lat. 52. 23.

ATTOLLENS, in anatomy, an appellation given to several muscles otherwise called *levatores* and *elevatores*. See ANATOMY, *Table of the Muscles*.

ATTORNEY AT LAW, answers to the Procurator, or Proctor of the civilians and canonists: And he is one who is put in the place, stead, or turn of another, to manage his matters of law. Formerly every suitor was obliged to appear in person, to prosecute or defend his suit (according to the old Gothic constitution), unless by special licence under the king's letters patent. This is still the law in criminal cases. And an idiot cannot to this day appear by attorney, but in person; for he hath not discretion to enable him to appoint a proper substitute; and upon his being brought before the court in so defenceless a condition, the judges are bound to take care of his interests, and they shall admit the best plea in his behalf that any one present can suggest. But, as in the Roman law, *cum olim in usu fuisset, alterius nomine agi non posse, sed, quia hoc non minimam incommoditatem habebat, cœperunt homines per procuratores litigare;* so, in England, on the same principle of convenience, it is now permitted in general, by divers ancient statutes, whereof the first is statute West. 2. c. 10. that attorneys may be made to prosecute or defend any action in the absence of the parties to the suit. These attorneys are now formed into a regular corps; they are admitted to the execution of their office by the superior courts of Westminster-hall; and are in all points officers of the respective courts in which they are admitted; and as they have many privileges on account of their attendance there, so they are peculiarly subject to the censure and animadversion of the judges. No man can practise as an attorney in any of those courts, but such as is admitted and sworn an attorney of that particular court; an attorney of the court of king's bench cannot practise in the court of common pleas; nor *vice versa*. To practise in the court of chancery, it is also necessary to be admitted a solicitor therein; and by the statute 22 Geo. II. c. 46. no person shall act as an attorney at the court of quarter-sessions, but such as has been regularly admitted in some superior court of record. So early as the statute 4 Henry IV. c. 18. it was enacted, that attorneys should be examined by the judges, and none admitted but such as were virtuous, learned, and sworn to do their duty. And many subsequent statutes have laid them under farther regulations.

Letter of attorney pays by different acts, 6s. By 25 Geo. III. c. 80. the following duties are to be paid by every solicitor, attorney, notary, proctor, agent or procurator, viz. for every warrant to prosecute for a debt of 40s. or to defend, a stamp duty of 2s. 6d. And they are to take out certificates annually; and if resident in London, Westminster, the bills of mortality, or Edinburgh, they are now obliged to pay L. 5 for the same; and in every other part of Great Britain, L. 3. The duties are under the management of the commissioners of stamps: and every acting solicitor, and other person as above, shall annually deliver in a note of his name and residence, to the proper officer of the court in which he practises; the entering officers are to certify notes delivered, and issue annual certificates, stamped as above, which must be renewed ten days before the expiration. Refusing to issue, or improperly issuing certificates, is a penalty of L. 50, and damages to the party aggrieved. Acting without a certificate, or giving in a false place of residence, is a penalty of L. 50, and incapacity to sue for fees due. A stamped memorandum shall be given to the proper officer, of the names of the parties in every action; and in such cases as used to require precipes. Officers who receive stamped memorandums, are to file the same, on penalty of L. 50; and persons not acting conformable to this act forfeit L. 5.

ATTORNEY General, is a great officer under the king, made by letters patent. It is his place to exhibit informations, and prosecute for the crown, in matters criminal; and to file bills in the exchequer, for any thing concerning the king in inheritance or profits; and others may bring bills against the king's attorney. His proper place in court, upon any special matters of a criminal nature, wherein his attendance is required, is under the judges on the left hand of the clerk of the crown; but this is only upon solemn and extraordinary occasions; for usually he does not sit there, but within the bar in the face of the court.

ATTOURNMENT, or ATTORNMENT, in law, a transfer from one lord to another of the homage and service a tenant makes; or that acknowledgment of duty to a new lord.

ATTRACTION, in natural philosophy, a general term used to denote the cause by which bodies tend towards each other, and cohere till separated by some other power.

The principle of attraction, in the Newtonian sense of it, seems to have been first surmised by Copernicus. "As for gravity," says Copernicus, "I consider it as nothing more than a certain natural appetence (*appetentia*) that the Creator has impressed upon all the parts of matter, in order to their uniting or coalescing into a globular form, for their better preservation; and it is credible that the same power is also inherent in the sun and moon, and planets, that those bodies may constantly retain that round figure in which we behold them." *De Rev. Orb. Cœlest.* lib. i. cap. 9. And Kepler calls gravity a corporeal and mutual affection between similar bodies, in order to their union. *Ast. Nov. in Introd.* And he pronounces more positively, that no bodies whatsoever were absolutely light, but only relatively so; and consequently, that all matter was subjected to the law of gravitation. *Ibid.*

The first in Britain who adopted the notion of attraction, was Dr Gilbert, in his book *De Magnete;* and the next was the celebrated Lord Bacon, *Nov. Org.* lib. ii. aphor. 36. 45. 48. *Sylv.* cent. i. exp. 33. In France it was received by Fermat and Roberval; and in Italy by Galileo and Borelli. But till Sir Isaac Newton appeared, this principle was very imperfectly defined and applied.

It must be observed, that though this great author makes use of the word attraction, in common with the school philosophers; yet he very studiously distinguishes between the ideas. The ancient attraction was supposed a kind of quality, inherent in certain bodies themselves, and arising from their particular or specific forms. The Newtonian attraction is a more indefinite principle; denoting not any particular kind or manner of action, nor the physical cause of such action; but only a tendency in the general, a *conatus accedendi*, to whatever cause, physical or metaphysical, such effect be owing; whether to a power inherent in the bodies themselves, or to the impulse of an external agent. Accordingly, that author, in his *Philosoph. Nat. Prin. Math.* notes, "that he uses the words *attraction*, *impulse*, and *propension* to the center, indifferently; and cautions the reader not to imagine that by attraction he expresses the modus of the action, or the efficient cause thereof, as if there were any proper powers in the centres, which in reality are only mathematical points; or, as if centres could attract." Lib. i. p. 5. So he "considers centripetal powers as attractions, though, physically speaking, it were perhaps more just to call them impulses. Ib. p. 147. He adds, "that what he calls attraction may possibly be effected by impulse, though not a common or corporeal impulse, or after some other manner unknown to us." *Optic.* p. 322.

Attraction, if considered as a quality arising from the specific form of bodies, ought, together with sympathy, antipathy, and the whole tribe of occult qualities, to be exploded. But when we have set these aside, there will remain innumerable phenomena of nature, and particularly the gravity or weight of bodies, or their tendency to a centre, which argue a principle of action seemingly distinct from impulse, where at least their is no sensible impulsion concerned. Nay, what is more, this action in some respects differs from all impulsion we know of; impulse being always found to act in proportion to the surfaces of bodies, whereas gravity acts according to their solid content, and consequently must arise from some cause that penetrates or pervades the whole substance thereof. This unknown principle, unknown we mean in respect of its cause, for its phenomena and effects are most obvious, with all the species and modifications thereof, we call *attraction;* which is a general name, under which all mutual tendencies, where no physical impulse appears, and which cannot therefore be accounted for from any known laws of nature, may be ranged.

And hence arise divers particular kinds of attraction; as, *Gravity*, *Magnetism*, *Electricity*, &c. which are so many different principles acting by different laws, and only agreeing in this, that we do not see any physical causes thereof; but that, as to our senses, they may really arise from some power or efficacy in such bodies, whereby they are enabled to act even upon distant bodies, though our reason absolutely disallows of any such action.

Attraction may be divided, with respect to the law it observes, into two kinds.

1. That which extends to a sensible distance. Such are the attraction of gravity, found in all bodies; and the attraction of magnetism and electricity, found in particular bodies. The several laws and phenomena of each, see under their respective articles.

The attraction of gravity, called also among mathematicians the *centripetal force*, is one of the greatest and most universal principles in all nature. We see and feel it operate on bodies near the earth, and find by observation that the same power (*i. e.* a power which acts in the same manner, and by the same rules, *viz.* always proportionably to the quantities of matter, and as the squares of the distances reciprocally) does also obtain in the moon, and the other planets, primary and secondary, as well as in the comets; and even that this is the very power whereby they are all retained in their orbits, &c. And hence, as gravity is found in all the bodies which come under our observation, it is easily inferred, by one of the settled rules of philosophizing, that it obtains in all others: and as it is found to be as the quantity of matter in each body, it must be in every particle thereof; and hence every particle in nature is proved to attract every other particle, &c. See the demonstration hereof laid down at large, with the application of the principle to the celestial motions, under the article ASTRONOMY, Sect. IV.

From this attraction arises all the motion, and consequently all the mutation, in the great world. By this heavy bodies descend, and light ones ascend; by this projectiles are directed, vapours and exhalations rise, and rains, &c. fall. By this rivers glide, the air presses, the ocean swells, &c. In effect, the motions arising from this principle make the subject of that extensive branch of mathematics, called *mechanics* or *statics*, with the parts or appendages thereof, hydrostatics, pneumatics, &c.

2. That which does not extend to sensible distances. Such is found to obtain in the minute particles whereof bodies are composed, which attract each other at or extremely near the point of contact, with a force much superior to that of gravity, but which at any distance from it decreases much faster than the power of

of gravity. This power a late ingenious author chooses to call the *attraction of cohesion*, as being that whereby the atoms or insensible particles of bodies are united into sensible masses.

This latter kind of attraction owns Sir Isaac Newton for its discoverer; as the former does for its improver. The laws of motion, percussion, &c. in sensible bodies under various circumstances, as falling, projected, &c. ascertained by the later philosophers, do not reach to those more remote, intestine motions of the component particles of the same bodies, whereon the changes of the texture, colour, properties, &c. of bodies depend: so that our philosophy, if it were only founded on the principle of gravitation, and carried so far as that would lead us, would necessarily be very deficient.

But beside the common laws of sensible masses, the minute parts they are composed of are found subject to some others, which have been but lately taken notice of, and are even yet imperfectly known. Sir Isaac Newton, to whose happy penetration we owe the hint, contents himself to establish that there are such motions in the *minima naturæ*, and that they flow from certain powers or forces, not reducible to any of those in the great world. In virtue of these powers, he shows, "That the small particles act on one another even at a distance; and that many of the phenomena of nature are the result thereof. Sensible bodies, we have already observed, act on one another divers ways; and as we thus perceive the tenor and course of nature, it appears highly probable that there may be other powers of the like kind: nature being very uniform and consistent with herself. Those just mentioned reach to sensible distances, and so have been observed by vulgar eyes; but there may be others which reach to such small distances as have hitherto escaped observation; and it is probable electricity may reach to such distances, even without being excited by friction."

The great author just mentioned proceeds to confirm the reality of these suspicions from a great number of phenomena and experiments, which plainly argue such powers and actions between the particles, *e. g.* of salts and water, oil of vitriol and water, aquafortis and iron, spirit of vitriol and saltpetre. He also shows, that these powers, &c. are unequally strong between different bodies; stronger, *e. g.* between the particles of salt of tartar and those of aquafortis than those of silver, between aquafortis and lapis calaminaris than iron, between iron than copper, copper than silver or mercury. So spirit of vitriol acts on water, but more on iron or copper, &c.

The other experiments which countenance the existence of such principle of attraction in the particles of matter are innumerable.

These actions, in virtue whereof the particles of the bodies abovementioned tend towards each other, the author calls by a general indefinite name, *attraction*; which is equally applicable to all actions whereby distant bodies tend towards one another, whether by impulse or by any other more latent power: and from hence he accounts for an infinity of phenomena, otherwise inexplicable, to which the principle of gravity is inadequate.

"Thus (adds our author) will nature be found very conformable to herself, and very simple; performing all the great motions of the heavenly bodies by the attraction of gravity, which intercedes those bodies, and almost all the small ones of their parts, by some other attractive power diffused through the particles thereof. Without such principles, there never would have been any motion in the world; and without the continuance thereof, motion would soon perish, there being otherwise a great decrease or diminution thereof, which is only supplied by these active principles."

We need not say how unjust it is in the generality of foreign philosophers to declare against a principle which furnishes so beautiful a view, for no other reason but because they cannot conceive how one body should act on another at a distance. It is certain, philosophy allows of no action but what is by immediate contact and impulsion (for how can a body exert any active power there where it does not exist? to supppose this of any thing, even the Supreme Being himself, would perhaps imply a contradiction): yet we see effects without seeing any such impulse; and where there are effects, we can easily infer there are causes whether we see them or no. But a man may consider such effects without entering into the consideration of the causes, as indeed it seems the business of a philosopher to do: for to exclude a number of phenomena which we do see, will be to leave a great chasm in the history of nature; and to argue about actions which we do not see, will be to build castles in the air.—It follows, therefore, that the phenomena of attraction are matters of physical consideration, and as such intitled to a share in the system of physics; but that the causes thereof will only become so when they become sensible, *i. e.* when they appear to be the effect of some other higher causes (for a cause is no otherwise seen than as itself is an effect, so that the first cause must from the nature of things be invisible): we are therefore at liberty to suppose the causes of attractions what we please, without any injury to the effects.—The illustrious author himself seems a little irresolute as to the causes; inclining sometimes to attribute gravity to the action of an immaterial cause (*Optics*, p. 343, &c.) and sometimes to that of a material one (Ib. p. 325.)

In his philosophy, the research into causes is the last thing, and never comes under consideration till the laws and phenomena of the effect be settled; it being to these phenomena that the cause is to be accommodated. The cause even of any, the grossest and most sensible action, is not adequately known. How impulse or percussion itself produces its effects, *i. e.* how motion is communicated by body to body, confounds the deepest philosophers; yet is impulse received not only into philosophy, but into mathematics: and accordingly the laws and phenomena of its effects make the greatest part of common mechanics.

The other species of attraction, therefore, in which no impulse is remarkable, when their phenomena are sufficiently ascertained, have the same title to be promoted from physical to mathematical consideration; and this without any previous inquiry into their causes, which our conceptions may not be proportionate to: let their causes be occult, as all causes strictly speaking are, so that their effects, which alone immediately concern us, be but apparent.

Our great philosopher, then, far from adulterating science with any thing foreign or metaphysical, as many have reproached him with doing, has the glory of having thrown every thing of this kind out of his system, and of having opened a new source of sublimer mechanics, which duly cultivated might be of infinitely greater extent than all the mechanics yet known. It is hence alone we must expect to learn the manner of the changes, productions, generations, corruptions, &c. of natural things; with all that scene of wonders opened to us by the operations of chemistry.

Some succeeding philosophers have prosecuted the discovery with laudable zeal: Dr Keil particularly has endeavoured to deduce some of the laws of this new action, and applied them to solve divers of the more general phenomena of bodies, as cohesion, fluidity, elasticity, softness, fermentation, coagulation, &c.; and Dr Friend, seconding him, has made a further application of the same principles, to account at once for almost all the phenomena that chemistry presents: so that some philosophers are inclined to think that the new mechanics should seem already raised to a complete science, and that nothing now can occur but what we have an immediate solution of from the attractive force.

But this seems a little too precipitate: A principle so fertile should have been further explored; its particular laws, limits, &c. more industriously detected and laid down, before we had proceeded to the application. Attraction in the gross is so complex a thing, that it may solve a thousand different phenomena alike. The notion is but one degree more simple and precise than action itself; and, till more of its properties are ascertained, it were better to apply it less and study it more. It may be added, that some of Sir Isaac Newton's followers have been charged with falling into that error which he industriously avoided, viz. of considering attraction as a cause or active property in bodies, not merely as a phenomenon or effect.

Attraction of Mountains. See MOUNTAINS.

Elective Attraction. See CHEMISTRY-*Index*.

ATTREBATII. See ATREBATII.

ATTRIBUTE, in a general sense, that which agrees with some person or thing; or a quality determining something to be after a certain manner. Thus understanding is an attribute of mind, and extension an attribute of body. That attribute which the mind conceives as the foundation of all the rest, is called its *essential attribute*: thus extension is by some, and solidity by others, esteemed the essential attributes of body or matter.

ATTRIBUTES, in theology, the several qualities or perfections of the Divine nature.

ATTRIBUTES, in logic, are the predicates of any subject, or what may be affirmed or denied of any thing.

ATTRIBUTES, in painting and sculpture, are symbols added to several figures, to intimate their particular office and character. Thus the eagle is an attribute of Jupiter; a peacock, of Juno; a caduce, of Mercury; a club, of Hercules; and a palm, of Victory.

ATTRIBUTIVES, in grammar, are words which are significant of attributes; and thus include adjectives, verbs, and participles, which are attributes of substances; and adverbs, which denote the attributes only of attributes. But Harris, who has introduced this distribution of words, denominates the former *attributives of the first order*, and the latter *attributives of the second order*.

ATTRITION, the rubbing or striking of bodies one against another, so as to throw off some of their superficial particles.

ATURÆ, an ancient town in the district of Novempopulana in Aquitania, on the river Aturus; now Aire in Gascony, on the Adour. E. Long. 0. 3. N. Lat. 43. 40.

AVA, a kingdom of Asia, in the peninsula beyond the Ganges. The king is very powerful, his dominions being bounded by Mogulstan on the west, Siam on the south, Tonquin and Cochin-China on the east, and by Tibet and China on the north. Several large rivers run through this country, which annually overflow their banks like the Nile, and thus render it extremely fertile. Here are mines of lead and copper, together with some of gold and silver, besides large quantities of the finest oriental rubies, sapphires, emeralds, &c.

AVA, the metropolis of the kingdom of the same name, is situated in E. Long. 96. 30. N. Lat. 21. 0. It is pretty large; the houses built with timber or bamboo canes, with thatched roofs, and floors made of teak plank or split bamboo. The streets are very straight, with rows of trees planted on each side. The king's palace is an exact quadrangle, each side of which is 800 paces, and is surrounded with a brick wall; but the palace itself is of stone. It has four gates: the golden gate, through which all ambassadors enter; the gate of justice, through which the people bring petitions, accusations, or complaints; the gate of grace, through which those pass who have received any favours, or have been acquitted of crimes laid to their charge; and the gate of state, through which his majesty himself passes when he shows himself to the people.

AVA AVA, a plant so called by the inhabitants of Otaheite, in the South Sea, from the leaves of which they express an intoxicating juice. It is drank very freely by the chiefs and other considerable persons, who vie with each other in drinking the greatest number of draughts, each draught being about a pint: but it is carefully kept from their women.

AVADOUTAS, a sect of Indian Bramins, who in austerity surpass all the rest. The other sects retain earthen vessels for holding their provisions, and a stick to lean on: but none of these are used by the Avadoutas; they only cover their nakedness with a piece of cloth; and some of them lay even that aside, and go stark naked, besmearing their bodies with cow-dung. When hungry, some go into houses, and, without speaking, hold out their hand; eating on the spot whatever is given them. Others retire to the sides of holy rivers, and there expect the peasants to bring them provisions, which they generally do very liberally.

AVAIL OF MARRIAGE, in Scots law, that casualty in ward-holding, by which the superior was intitled to a certain sum from his vassal, upon his attaining the age of puberty, as the value or avail of his tocher.

AVALANCHES, a name given to prodigious snow-balls that frequently roll down the mountains in Savoy

Savoy, particularly Mount Blanc, to the extreme danger of such adventurous travellers as attempt to ascend those stupendous heights. Some of the avalanches are about 200 feet diameter; being fragments of the ice-rocks which break by their own weight from the tops of the precipices. See *Mount Blanc*.

AVALON, a small but ancient city of Burgundy in France, about 500 paces long and 300 broad. E. Long. 3. 5. N. Lat. 47. 38.

AVANIA, in the Turkish legislature, a fine for crimes and on deaths, paid to the governor of the place. In the places wherein several nations live together under a Turkish governor, he takes this profitable method of punishing all crimes among the Christians or Jews, unless it be the murder of a Turk.

AVARICUM, an ancient town of the Bituriges in Gallia Celtica, situated on the rivulet Avara, in a very fertile soil (Cæsar). Now *Bourges* in Berry. E. Long. 2. 30. N. Lat. 47. 10.

AVAST, in the sea-language, a term requiring to stop, or to stay.

AVAUNCHERS, among hunters, the second branches of a deer's horns.

AUBAGNE, a town of Provence in France, situated on the river Veaune, on the road from Marseilles to Toulon. The states sometimes hold their sessions at this place. E. Long. 5. 52. N. Lat. 43. 17.

AUBAINE, in the customs of France, a right vested in the king of being heir to a foreigner that dies within his dominions.

By this right the French king claims the inheritance of all foreigners that die within his dominions, notwithstanding of any testament the deceased could make. An ambassador is not subject to the right of aubaine; and the Swiss, Savoyards, Scots, Portuguese, and citizens of the United States of North-America, are also exempted, being deemed natives and regnicoles.

AUBENAS, a town of Languedoc in France, situated on the river Ardesche, at the foot of the mountains called the *Cevennes*, E. Long. 4. 32. N. Lat. 44. 40.

AUBENTON, a town of Picardy in France, situated on the river Aube. E. Long. 4. 25. N. Lat. 49. 51.

AUBETERRE, a town of France in the Angoumois, on the river Dronne. E. Long. 0. 10. N. Lat. 45. 15.

AUBIGNE, a town of Berry in France, situated on the river Verre, in a flat agreeable country. It is surrounded with high strong walls, wide ditches, and high counterscarps. The castle is within the town, and is very handsome. E. Long. 2. 20. N. Lat. 47. 29.

AUBIGNY, a dukedom in France belonging to the Dukes of Richmond in England; confirmed to the present duke, and registered in the parliament of Paris 1777.

AUBIN DU COMIER, a town of Britanny in France. W. Long. 1. 15. N. Lat. 48. 15.

AUBIN, in horsemanship, a broken kind of gate, between an amble and a gallop, accounted a defect.

AUBONNE, a town of Switzerland, in the canton of Bern. E. Long. 5. 54. N. Lat. 48. 30. It is situated near a river of the same name, seven miles north of the lake of Geneva, upon an eminence which has a gentle declivity, at the foot of which runs the river with an impetuous torrent. The town is built in the form of an amphitheatre; on the upper part of which stands a very handsome castle with a fine court, and a portico supported by pillars of a single stone each; above there is a covered gallery that runs round the court; and as the castle stands high, there is a most delightful prospect, not only of the town and neighbouring fields, but of the whole lake of Geneva and the land that surrounds it. At Thonen, in Savoy on the other side of the lake, is a town covered with tin, which makes a glittering appearance when the sun is in a certain position; and the castle of Aubonne has likewise a tower of the same kind, which at certain hours makes a similar appearance to the Savoyards. The balliage of Aubonne contains several villages, which are mostly at the foot of the mountain Jura. In one part of this mountain there is a very deep cave, wherein those that go down find a natural and perpetual ice-house. At the bottom is heard a great noise like that of a subterraneous river, which is supposed to be that of the river Aubonne, because it first appears, with several sources, about 100 paces from the foot of that mountain.

AUBREY (John), a famous English antiquary, descended from an ancient family in Wiltshire, was born in 1626. He made the history and antiquities of England his peculiar study and delight; and contributed considerable assistance to the famous *Monasticon Anglicanum*. He succeeded to several good estates; but law-suits and other misfortunes consumed them all, so that he was reduced to absolute want. In this extremity he found a valuable benefactress in the Lady Long of Draycot in Wilts, who gave him an apartment in her house, and supported him to his death, which happened about the year 1700. He was a man of capacity, learning, and application, a good Latin poet, an excellent naturalist, but somewhat credulous, and tinctured with superstition. He left many works behind him. He wrote, 1. Miscellanies. 2. A Perambulation of the county of Surry, in five volumes, octavo. 3. The Life of Mr Hobbes of Malmsbury. 4. *Monumenta Britannica*, or a discourse concerning Stonehenge, and Roll-Rich stones in Oxfordshire. 5. *Architectonica Sacra;* and several other works still in manuscript.

AUBURN, a market-town in Wiltshire, in England. W. Long. 1. 20. N. Lat. 53. 20.

AUBUSSON, a small town of France, in the province of La Marche, and the government of the Lyonnois. Its situation is very irregular, on the river Creuse, in a bottom surrounded with rocks and mountains. A manufacture of tapestry is carried on here, by which the town is rendered very populous. E. Long. 2. 15. N. Lat. 45. 58.

AUCAUGREL, the capital of the kingdom of Adel in Africa, seated on a mountain. E. Long. 44. 25. N. Lat. 9. 10.

AUCH, a city of France, the capital of the county of Armagnac, and the metropolis of all Gascony. The archbishop assumes the title of primate of Aquitain. It lies on the summit and declivity of a very steep hill, which is surrounded by other hills that rise at a small distance; and through the vale below runs a rivulet, called the *Gers*. The inhabitants are about 6000; the buildings are modern and elegant; the streets, though in general narrow, yet are clean and well

well paved. In the centre of the city ſtands the cathedral, which is one of the moſt magnificent in France, both as to its conſtruction and the internal decorations. The painted windows are only inferior to thoſe of Gouda in Holland. The chapels are of equal beauty, and ornamented at a prodigious expence. The revenues of the ſee of Auch, amount annually to three hundred thouſand livres. The palace is a very handſome building; and its apartments are furniſhed with a voluptuous ſplendor, rather becoming a temporal than a ſpiritual prince. E. Long. 0. 40. N. Lat. 43. 40.

AUCTION, a kind of public ſale, very much in uſe for houſehold goods, books, plate, &c. By this method of ſale the higheſt bidder is always the buyer. This was originally a kind of ſale among the ancient Romans, performed by the public crier *ſub haſta, i. e.* under a ſpear ſtuck up on that occaſion, and by ſome magiſtrate, who made good the ſale by delivery of the goods.

AUDEUS, the chief of the Audeans, obtained the name of an heretic, and the puniſhment of baniſhment, for celebrating Eaſter in the manner of the Jews, and attributing an human form to the Deity. He died in the country of the Goths, about the year 370.

AUDEANISM, the ſame with anthropomorphiſm. See ANTHROPOMORPHITES.

AUDIENCE given to ambaſſadors, a ceremony obſerved in courts at the admiſſion of ambaſſadors or public miniſters to a hearing.

In England, audience is given to ambaſſadors in the preſence-chamber; to envoys and reſidents, in a gallery, cloſet, or in any place where the king happens to be. Upon being admitted, as is the cuſtom of all courts, they make three bows; after which they cover and ſit down; but not before the king is covered and ſat down, and has given them the ſign to put on their hats. When the king does not care to have them covered, and ſit, he himſelf ſtands uncovered; which is taken as a ſlight. At Conſtantinople, miniſters uſually have audience of the prime vizier.

AUDIENCE is alſo the name of a court of juſtice eſtabliſhed in the Weſt-Indies by the Spaniards, anſwering in effect to the parliament in France. Theſe courts take in ſeveral provinces, called alſo *audiences* from the names of the tribunal to which they belong.

AUDIENCE is alſo the name of an eccleſiaſtical court held by the archbiſhop of Canterbury, wherein differences upon elections, conſecrations, inſtitutions, marriages, &c. are heard.

AUDIENDO & TERMINANDO, a writ, or rather a commiſſion to certain perſons, when any inſurrection or great riot is committed in any place, for the appeaſing and puniſhment thereof.

AUDIENTES, or AUDITORES, in church-hiſtory, an order of catechumens; conſiſting of thoſe newly inſtructed in the myſteries of the Chriſtian religion, and not yet admitted to baptiſm.

AUDIT, a regular hearing and examination of an account by ſome proper officers, appointed for that purpoſe.

AUDITOR, in a general ſenſe, a hearer, or one who liſtens and attends to any thing.

AUDITOR, according to the Engliſh law, is an officer of the king, or ſome other great perſon, who, by examining yearly the accounts of the under officers, makes up a general book, with the difference between their receipts and charges, and their allowances to allocations.

AUDITORS of the Receipts, is an officer of the exchequer who files the tellers bills, makes an entry of them, and gives the lord treaſurer a certificate of the money received the week before. He alſo makes debentures to every teller, before they receive any money, and takes their accounts. He keeps the black book of receipts, and the treaſurer's key of the treaſury, and ſees every teller's money locked up in the new treaſury.

AUDITORS of the Revenue, or of the exchequer, officers who take the accounts of thoſe who collect the revenues and taxes raiſed by parliament, and take the accounts of the ſheriffs, eſcheators, collectors, tenants, and cuſtomers, and ſet them down in a book, and perfect them.

AUDITORS of the Preſt and Impreſt, officers of the exchequer, who take and make up the accounts of Ireland, Berwick, the mint, and of any money impreſſed to any man for the king's ſervice. They received poundage on all accounts paſſed by them, which amounted to a prodigious ſum, eſpecially in time of war. But the office is now aboliſhed, and L. 7000 a year given to the incumbents.

AUDITORS Collegiate, Conventual, &c. officers formerly appointed in colleges, &c. to examine and paſs their accounts.

AUDITORES, in church hiſtory. See AUDIENTES.

The auditores formed one branch of the Manichean ſect, which was divided into *elect* and *auditors*; correſponding, according to ſome writers, to *clergy* and *laity*; and according to others, to the *faithful* and *catechumens* among the Catholics. By the Manichean rule, a different courſe of life was preſcribed to the elect from that of the auditors. The latter might eat fleſh, drink wine, bathe, marry, traffic, poſſeſs eſtates, bear magiſtracy, and the like; all which things were forbidden to the elect. The auditors were obliged to maintain the elect, and kneeled down to aſk their bleſſing. Beauſobre obſerves, that the elect were eccleſiaſtics, and in general ſuch as made profeſſion of obſerving certain counſels, called *evangelic*; ſuch as the clergy and Monks; and they were called the *perfect* by Theodoret. The auditors were the laity, and ſo denominated, becauſe they heard in the church whilſt others taught and inſtructed.

AUDITORIUM, in the ancient churches, was that part of the church where the audientes ſtood to hear and be inſtructed.

The auditorium was that part now called *navis eccleſiæ* *. In the primitive times, the church was ſo ſtrict in keeping the people together in that place, that the perſon who went from thence in ſermon-time was ordered by the council of Carthage to be excommunicated.

* See Nave.

AUDITORY, ſomething relating to the ſenſe of hearing.

AUDITORY, or AUDIENCE, an aſſembly of people who attend to hear a perſon that ſpeaks in public.

Auditory ‖ Audran.

AUDITORY is alſo uſed for the bench whereon a magiſtrate or judge hears cauſes.

AUDITORY, in ancient churches. See AUDITORIUM.

AUDITORY Paſſage, (meatus auditorius), in anatomy; the entrance of the ear. See ANATOMY, p. 763, nº 141.

AUDITORY Nerves. See ANATOMY, p. 760.

AUDRAN (Claude), a French engraver, the firſt of the celebrated artiſts of that name, was the ſon of Lewis Audran, an officer belonging to the wolf-hunters in the reign of Henry IV. of France; and was born at Paris in 1592. He never made any great progreſs in the art; ſo that his prints are held in little or no eſtimation. Yet though he acquired no great reputation by his own works, it was no ſmall honour to him to be the father of three great artiſts, Germain, Claude, and Girard; the laſt of whom has immortalized the name of the family for ever. Claude Audran retired from Paris to Lyons, where he reſided, and died in 1677.

AUDRAN (Carl), a very eminent engraver, was brother to the preceding, though ſome aſſert he was only his couſin-german, and was born at Paris in 1594. In his infancy he diſcovered much taſte, and a great diſpoſition for the arts; and to perfect himſelf in engraving, which he appears to have been chiefly fond of, he went to Rome, where he produced ſeveral prints that did him great honour. At his return, he adopted that ſpecies of engraving which is performed with the graver only. He ſettled at Paris, where he died in 1674, without having ever been married. The Abbé Marolles, who always ſpeaks of this artiſt with great praiſe, attributes 130 prints to him: amongſt which, the *annunciation*, a middling-ſized plate, upright, from Annabale Carracci; and the *aſſumption*, in a circle, from Domenichino, are the moſt eſteemed. In the early part of his life he marked his prints with C, or the name of Carl, till his brother Claude publiſhed ſome plates with the initial only of his baptiſmal name; when, for diſtinction ſake, he uſed the letter K, or wrote his name Karl, with the K inſtead of the C.

AUDRAN (Germain), the eldeſt ſon of Claude, mentioned in the preceding article but one, was born in 1631 at Lyons, where his parents then reſided. Not content with the inſtructions of his father, he went to Paris, and perfected himſelf under his uncle Carl; ſo that, upon his return to Lyons, he publiſhed ſeveral prints which did great honour to his graver. His merit was in ſuch eſtimation, that he was made a member of the academy eſtabliſhed in that town, and choſen a profeſſor. He died at Lyons in 1710, and left behind him four ſons, all artiſts; namely, Claude, Benoiſt, John, and Louis.

AUDRAN (Claude), the ſecond of this name, and ſecond ſon to Claude abovementioned, was born at Lyons in 1639, and went to Rome to ſtudy painting, where he ſucceeded ſo well, that at his return he was employed by Le Brun to aſſiſt him in the battles of Alexander, which he was then painting for the king of France. He was received into the Royal Academy in the year 1675, and died unmarried at Paris in 1684. His virtues, (ſays Abbé Fontenai) were as praiſe-worthy as his talents were great. M. Heineken mentions this artiſt as an engraver, without ſpecifying any of his works in that line. Audran.

AUDRAN (Girard, or Gerard), the moſt celebrated artiſt of the whole family of the Audrans, was the third ſon of Claude Audran mentioned in a preceding article, and born at Lyons, in 1640. He learned from his father the firſt principles of deſign and engraving; and following the example of his brother, he left Lyons and went to Paris, where his genius ſoon began to manifeſt itſelf. His reputation there brought him to the knowledge of Le Brun, who employed him to engrave the *battle of Conſtantine*, and the *triumph* of that emperor; and for theſe works he obtained apartments at the Gobelins. At Rome, whither he went for improvement, he is ſaid to have ſtudied under Carlo Maratti, in order to perfect himſelf in drawing; and in that city, where he reſided three years, he engraved ſeveral fine plates. M. Colbert, that great encourager of the arts, was ſo ſtruck with the beauty of Audran's works while he reſided at Rome, that he perſuaded Louis XIV. to recall him. On his return, he applied himſelf aſſiduouſly to engraving; and was appointed engraver to the king, from whom he received great encouragement. In the year 1681 he was named counſellor of the Royal Academy; and died at Paris in 1703. He had been married; but left no male iſſue behind him.

Strutt's Dictionary.

The great excellency of this artiſt above that of any other engraver was, that though he drew admirably himſelf, yet he contracted no manner of his own; but tranſcribed on copper ſimply, with great truth and ſpirit, the ſtyle of the maſter whoſe pictures he copied. On viewing his prints you loſe ſight of the engraver, and naturally ſay, it is Le Brun, it is Pouſſin, it is Mignard, or it is Le Sueur, &c. as you turn to the prints which he engraved from thoſe maſters. Let any one examine the *battles* above-mentioned from Le Brun, the *preſervation of the young Pyrrhus* from Nicholas Pouſſin, the *peſt* from Mignard, and the *martyrdom of St Lawrence* from Le Sueur, and then judge candidly of the truth of this obſervation. The following judicious obſervations by the Abbé Fontenai, taken chiefly from M. Baſan, with ſome ſmall variation and additions, will fully illuſtrate the merits of Gerard Audran. "This ſublime artiſt, far from conceiving that ſervile arrangement of ſtrokes, and the too frequently cold and affected clearneſs of the graver, were the great eſſentials of hiſtorical engraving, gave worth to his works by a bold mixture of free hatchings and dots, placed together apparently without order, but with an inimitable degree of taſte; and has left to poſterity moſt admirable examples of the ſtyle in which grand compoſitions ought to be treated. His greateſt works, which have not a very flattering appearance to the ignorant eye, are the admiration of true connoiſſeurs and perſons of fine taſte. He acquired the moſt profound knowledge of the art by the conſtant attention and ſtudy which he beſtowed upon the ſcience of deſign, and the frequent uſe he made of painting from nature. This great man always knew how to penetrate into the genius of the painter he copied from; often improved upon, and ſometimes even ſurpaſſed him. Without exception, he was the moſt celebrated engraver that ever exiſted in the hiſtorical line. We have several subjects which he engraved from his own designs, that manifested as much taste as character and facility. But, in the *battles of Alexander*, he surpassed even the expectations of Le Brun himself." These consist of three very large prints, length-ways, each consisting of four plates, which join together, from Le Brun, namely, *the passage of the Granicus; the battle of Arbela; Porus brought to Alexander*, after his defeat.—To this set are added two more large prints, length-ways, on two plates each, also from Le Brun, as follow: *Alexander entering the tent of Darius;* and *The Triumphal entry of Alexander into Babylon.* The former was engraved by Girard Edelink, and the latter by Girard Audran. It is to be remarked of all these plates, that those impressions are generally most esteemed which have the name of Goyton the printer marked upon them.—The *Pest*, from Peter Mignard, a large plate, length-ways, also deserves particular notice. In the first impressions, the figure in the clouds is Juno with her peacock behind her; in the latter, the peacock is obliterated, and the wings of an angel are added to the figure.

AUDRAN (Benoit), the second son of Germain Audran, was born at Lyons, in 1661, where he learned the first principles of design and engraving under the instruction of his father. But soon after going to Paris, his uncle Girard Audran took him under his tuition; and Benoit so greatly profited by his instructions, that though he never equalled the sublime style of his tutor, yet he deservedly acquired great reputation. Nay, the Abbé Fontenai adds this eulogium: "We admire in his works a share of those beauties which we find in the engravings of the illustrious Girard." He was honoured with the appellation of the king's engraver, and received the royal pension. He was made an academician, and admitted into the council in 1715. He died unmarried at Louzouer, where he had an estate, in 1721. His manner was founded on the bold clear style of his uncle. His outlines were firm and determined; his drawing correct; the heads of his figures are in general very expressive; and the other extremities well marked. His works, when compared with those of his uncle, appear to want that mellowness and harmony which are so conspicuous in the latter; they are more dry; and the round dots with which he finishes his flesh upon the lights are often too predominant. In his most finished plates, we find the mechanical part of the engraving extremely neat, and managed with great taste and judgment. Among his neatest prints may be reckoned that which represents *Alexander sick*, drinking from the cup which his physician presents to him; a circular plate, from Le Sueur.

AUDRAN (John), the third son of Germain Audran, was born at Lyons in 1667; and, after having received instructions from his father, went to Paris to perfect himself in the art of engraving under his uncle Girard Audran. At the age of 20 years, the genius of this great artist begun to display itself in a surprising manner; and his future success was such, that in 1707, he obtained the title of engraver to the king, and had a pension allowed him by his majesty, with apartments in the Gobelins; and the following year he was made a member of the Royal Academy. He was 80 years of age before he quitted the graver; and near 90 when he died at his apartments assigned him by the king. He left three sons behind him; one of whom was also an engraver, as we shall see below. "The most masterly and best prints of this artist (in Mr Strutt's opinion) are those which are not so pleasing to the eye at first sight. In these the etching constitutes a great part; and he has finished them in a bold rough style. The scientific hand of the master appears in them on examination. The drawing of the human figure, where it is shewn, is correct. The heads are expressive and finely finished; the other extremities well marked. He has not, however, equalled his uncle. He wants that harmony in the effect; his lights are too much and too equally covered; and there is not sufficient difference between the style in which he has engraved his back grounds and his draperies. This observation refers to a fine print by him of Athaliah, and such as he engraved in that style. At other times he seems almost to have quitted the point, and substituted the graver. But here I think he has not so well succeeded. The effect is cold and silvery: see, for example, the *Andromache* from Sylvestre. One of his best finished prints, in this neat style, seems to me to be *Cupid* and *Psyche* from Ant. Coypel."

AUDRAN (Louis), the last son of Germain Audran, was born at Lyons in 1670; from whence he went to Paris, after the example of his brothers, to complete his studies in the school of his uncle Girard. He died suddenly at Paris in 1712, before he had produced any great number of prints by his own hand. He assisted, it is presumed, his brothers in their more extensive works. Among the most esteemed prints by this artist are *the seven acts of mercy*, on seven middling-sized plates, length-ways, from Sebastian Bourdon.

AUDRAN (Benoit), the second engaver of that name, was the son of John Audran, and nephew to the former Benoit; and was also established at Paris. He engraved but a few plates. It is necessary, however, to be careful not to confound him with his uncle. But a little attention will easily prevent this mistake; for the second Benoit is vastly inferior to the first in point of merit. We have some few portraits by this artist; and among other plates, *the descent from the cross*, from a picture of Poussin.

AVEIRO, a considerable city of Portugal, seated near the head of a small gulf formed by the tide at the mouth of the river Vouga. This river forms a small haven with a bar, over which vessels may pass that do not draw above eight or nine feet water. The city stands in a long plain, well watered, and very fertile. This plain is nine miles broad, from Porto to Coimbro; and is bounded on the east by a chain of mountains called *Sara d'Alcoba*, which reach from the one town to the other. Near this city there is salt made in sufficient quantity to serve two or three provinces. Here is a remarkable nunnery, where none are received but the daughters of the ancient nobility. The inhabitants of Aveiro have the singular privilege, that no stranger whatever can pass a night there without leave of the magistrate. W. Long. 9. 8. N. Lat. 40. 30.

AVELLANE, in heraldry, a cross, the quarters of which somewhat resemble a filbert-nut. Sylvanus Morgan says, that it is the cross which ensigns the mound of authority, or the sovereign's globe.

AVELLINO, a city of Italy, in the kingdom of Naples, with a bishop's see. It was almost ruined by an an earthquake in 1694. It is, however, at present a pretty considerable place, extending a mile in length down the declivity of a hill, with ugly streets but tolerable houses. The churches have nothing to recommend them, being crowded with monstrous ornaments in a barbarous style, which the Neapolitans seem to have borrowed from the Spaniards. The cathedral is a poor building, in a wretched situation, with little to attract the eye. The good people here need not run to Naples to see the blood of St. Januarius; for they have a statue of St Lawrence, with a phial of his blood, which for eight days in August entertains them with a similar miraculous liquefaction. Their only edifice of note is a public granary, of the Composite order, adorned with antique statues, and a very elegant bronze one of Charles II. of Spain, while a boy, cast by Cavalier Cosimo. The number of inhabitants amounts to 8000, some say 10,000. The bishop's revenue is about 6000 ducats (L. 1125) a-year. The magistracy consists of a Syndic and four Eletti, all annual; which offices are engrossed by a certain number of families of some distinction, that neither intermarry nor associate with the rest of the burghers. There is a considerable manufacture of cloth here of various qualities and colours, but chiefly blue. Many wealthy merchants have a concern in this business, some with a capital of eighty thousand ducats (L. 15,000). The poor women who spin the wool must work very hard to earn above four grana a-day. The second article of trade is maccaroni and paste of many kinds, which being of an excellent quality, are in high repute all over the country. Wooden chairs are also made and sold here in great quantities. Avellino abounds with provisions of every sort; each street is supplied with wholesome water; the wine is but indifferent. The soil of this district, which consists chiefly of volcanic substances, produces little corn, but fruit in abundance, of which the apple is deservedly held in great esteem. The most profitable, however, of all its fruit-trees is the hazel. Nut bushes cover the face of the valley, and in good years bring in a profit of sixty thousand ducats (L. 11,250). The nuts are mostly of the large round species of filbert, which we call *Spanish*. These bushes were originally imported into Italy from Pontus, and known among the Romans by the appellation of *Nux Pontica*, which in process of time was changed into that of *Nux Avellana*, from the place where they had been propagated with the greatest success. The proprietors plant them in rows, and by dressing, form them into large bushes of many stems. Every year they refresh the roots with new earth, and prune off the straggling shoots with great attention.

AVE-MARIA, the angel Gabriel's salutation of the Virgin Mary, when he brought her the tidings of the incarnation.—It is become a prayer or form of devotion in the Romish church. Their chaplets and rosaries are divided into so many ave-marias, and so many pater-nosters, to which the Papists ascribe a wonderful efficacy.

AVENA, OATS: A genus of the digynia order, belonging to the triandria class of plants; and in the natural method ranking under the 4th order, *Gramina*. The calyx has a double valve, and the awn on the back is contorted. The species are 13; six of them natives of Britain: *viz.* 1. The nuda, or naked oats. 2. The fatua, or bearded oat-grass. 3. The pratensis, or meadow oat-grass. 4. The pubescens, or rough oat-grass. 5. The elatior, or tall oat-grass. 6. The flavescens, or yellow oat-grass. It is remarkable, that the native place of the sativa, or common oat, cultivated in our fields, is almost totally unknown. Anson says, that he observed it growing wild or spontaneously in the island of Juan Fernandez. But a vague observation from an author of that kind is not to be depended on.—For the culture, see AGRICULTURE, n° 137.

Oats are an article of the materia medica. Gruels made from them have a kind of soft mucilaginous quality; by which they obtund acrimonious humours, and prove useful in inflammatory diseases, coughs, hoarseness, and exulcerations of the fauces.

AVENACEOUS, something belonging to or partaking of the nature of oats.

AVENAGE, in law, a certain quantity of oats paid by a tenant to a landlord, instead of rent or some other duties.

AVENCHE, an ancient city of Switzerland, in the canton of Bern, formerly the capital of all Switzerland, but now shows its former greatness only by its ruins. E. Long. 7. 7. N. Lat. 46. 50.

AVENES, a small but strong town in French Flanders, in the county of Hainalt, seated on the river Thespes. It contains about 2500 inhabitants; but the houses are wretchedly built, and the streets irregular. It was fortified by M. Vauban in a strong regular manner. About this place are a prodigious number of white stones proper for building, and used by sculptors for statues: they are known by the name of *Stones of Avenes*. E. Long. 3. 40. N. Lat. 50. 10.

AVENIO, an ancient town of the Cavares, and one of the most opulent in Gallia Narbonensis; now *Avignon*, in Provence. See AVIGNON.

AVENOR, an officer belonging to the king's stables, who provides oats for the horses. He acts by warrant from the master of the horse.

AVENS, in botany. See CARIOPHILLUS.

AVENTINE (John, author of the Annals of Bavaria, was born of mean parentage, in the year 1466, at Abensperg in the country just named. He studied first at Ingoldstadt, and afterwards in the university of Paris. In 1503, he privately taught eloquence and poetry at Vienna; and in 1507, he publicly taught Greek at Cracow in Poland. In 1509, he read lectures on some of Cicero's pieces at Ingoldstadt; and in 1512, was appointed to be preceptor to prince Lewis and prince Ernest, sons of Albert the Wise, duke of Bavaria; and travelled with the latter of those two princes. After this he undertook to write the Annals of Bavaria, being encouraged by the dukes of that name, who settled a pension upon him, and gave him hopes that they would defray the charges of the book. This work, which gained its author great reputation, was first published in 1554, by Jerome Zeiglerus, professor of poetry in the university of Ingoldstadt; and afterwards at Brasil in 1580, by Nicholas Cisner. An affront which Aventine received in the year 1529, stuck by him all the rest of his life: he was forcibly taken out of his sister's house at Abensperg, and hurried to a jail; the true cause of which violence was never known: but it would probably have been carried to a much greater length, had not the Duke of Bavaria interposed, and taken this learned man into his protection. Mr Bayle remarks, that the incurable melancholy which from this time possessed Aventine, was so far from determining him to lead a life of celibacy, as he had done till he was 64, that it induced him perhaps to think of marrying. The violence of his new passion was not, however, so great, but that it suffered him to advise with two of his friends, and consult certain passages of the bible relative to marriage. The result was, that it was best for him to marry; and having already lost too much time, considering his age, he took the first woman he met with, who happened to be his own maid, ill-tempered, ugly, and extremely poor. He died in 1534, aged 68; leaving one daughter, who was then but two months old. He had a son, who died before.

AVENTINUS MONS, one of the seven hills on which ancient Rome stood. The origin of the name *Aventinus* is uncertain: but this hill was also called *Murcius*, from Murcia the goddess of sloth, who had a little chapel there; and *Collis Dianæ*, from the temple of Diana; likewise *Remonius*, from Remus, who wanted to build the city and who was buried there. It was taken within the compass of the city by Ancus Marcius. To the east it had the city walls; to the south the Campus Figulinus; to the west, the Tiber; and to the north, Mons Palatinus, in circuit two miles and a quarter.

AVENTURE, in law-books, means a mischance causing the death of a person without felony.

AVENUE, in gardening, a walk planted on each side with trees, and leading to an house, garden-gate, wood, &c. and generally terminated by some distant object.

All avenues that lead to a house ought to be at least as wide as the whole front of the house, if wider they are better still; and avenues to woods and prospects ought not to be less than 60 feet wide. The trees should not be planted nearer to one another than 35 feet, especially if they are trees of a spreading kind; and the same ought to be the distance, if they are for a regular grove.

The trees most proper for avenues with us, are the English elm, the lime, the horse-chesnut, the common chesnut, the beach, and the abele. The English elm will do in all grounds, except such as are very wet and shallow; and this is preferred to all other trees, because it will bear cutting, heading, or lopping in any manner, better than most others. The rough or smooth Dutch elm is approved by some, because of its quick growth; this is a tree which will bear removing very well, it is also green almost as soon as any plant whatever in spring, and continues so as long as any, and it makes an incomparable hedge, and is preferable to all other trees for lofty espaliers. The lime is valued for its natural growth and fine shade. The horse-chesnut is proper for all places that are not too much exposed to rough winds. The common chesnut will do very well in a good soil; and rises to a considerable height, when planted somewhat close; though, when it stands single, it is rather inclined to spread than to grow tall. The beech is a beautiful tree, and naturally grows well with us in its wild state; but it is less to be chosen for avenues than the before-mentioned, because it does not bear transplanting well, but it is very subject to miscarry. Lastly, the abele is fit for any soil, and is the quickest grower of any forest-tree. It seldom fails in transplanting; and succeeds very well in wet soils, in which the others are apt to fail. The oak is but little used for avenues, because of its slow growth.

The old method of planting avenues was with regular rows of trees, and this has been always kept to till of late: but we have now a much more magnificent way of planting avenues; this is by setting the trees in clumps, or platoons, making the opening much wider than before, and placing the clumps of trees at about 300 feet distant from one another. In each of these clumps there should be planted either seven or nine trees; but it is to be observed, that this is only to be practised where the avenue is to be of some considerable length, for in short walks this will not appear so sightly as single rows of trees. The avenues made by clumps are fittest of all for parks. The trees in each clump should be planted about 30 feet asunder; and a trench should be thrown up round the whole clump, to prevent the deer from coming to the trees to bark them.

AVENZOAR, ABU MERWAN ABDALMALEC EBN ZOHR, an eminent Arabian physician, flourished about the end of the eleventh or the beginning of the twelfth century. He was of noble descent, and born at Seville, the capital of Andalusia, where he exercised his profession with great reputation. His grandfather and father were both physicians. The large estate he inherited from his ancestors, set him above practising altogether for gain: he therefore took no fees from the poor, or from artificers, though he refused not the presents of princes and great men. His liberality was extended even to his enemies; for which reason he used to say, that they hated him not for any fault of his, but rather out of envy. Dr Friend writes, that he lived to the age of 135; that he began to practise at 40, or (as others say) at 20; and had the advantage of a longer experience than almost any one ever had, for he enjoyed perfect health to his last hour. He left a son, known also by the name of *Ebn Zohr*, who followed his father's profession, was in great favour with Al Manzûr emperor of Morocco, and wrote several treatises of physic.

Avenzoar was cotemporary with Averroes, who, according to Leo Africanus heard the lectures of the former, and learned physic of him; this seems the more probable, because Averroes more than once gives Avenzoar a very high and deserved encomium, calling him *admirable*, *glorious*, *the treasure of all knowledge*, and *the most supreme in physic from the time of Galen to his own*. Avenzoar, notwithstanding, is by the generality of writers reckoned an empiric: But Dr Friend observes, that this character suits him less than any of the rest of the Arabians. "He was bred," continues that author, "in a physical family, his father and grandfather being both practitioners, whom he always remembers with great gratitude and honour. We have his own testimony that he had a regular education; and that he not only learned what properly belongs to a physician, but, out of a great desire of knowledge, every thing besides which relates to pharmacy or surgery." Dr Friend afterwards observes, "that he was averse to quackery, and rejects the idle superstitions of astrologers; and throughout all his work professes himself

ſelf ſo much of the dogmatical or rational ſect, which was directly oppoſite to the empirical, that he has a great deal of reaſoning about the cauſes and ſymptoms of diſtempers; and as in his theory he chiefly, if not only, follows Galen, ſo he quotes him upon all occaſions, oftener than the reſt of the Arabians do. Notwithſtanding he is ſo Galenical, there are ſeveral particulars in him which ſeldom or never occur in other authors; and there are ſome caſes which he relates from his own experience, which are worth peruſing." He wrote a book entitled, *Tayaſſir fi'lmadâwât w'altadbîr*, i. e. "The method of preparing medicines and diet:" which is much eſteemed. This work was tranſlated into Hebrew, in the year of Chriſt 1280, and thence into Latin by Paravicius, whoſe verſion has had ſeveral editions. The author added a ſupplement to it, under the title of *Jâmé*, or *a Collection*. He alſo wrote a treatiſe *Fi'ladwiyat wa'laughdiyat*, i. e. "Of Medicines and Food;" wherein he treats of their qualities.

AVERAGE, in commerce, ſignifies the accidents and misfortunes which happen to ſhips and their cargoes, from the time of their loading and ſailing to their return and unloading; and is divided into three kinds. 1. The ſimple or particular average, which conſiſts in the extraordinary expences incurred for the ſhip alone, or for the merchandizes alone. Such is the loſs of anchors, maſts, and rigging, occaſioned by the common accidents at ſea; the damages which happen to merchants by ſtorm, prize, ſhipwreck, wet, or rotting; all which muſt be borne and paid by the thing which ſuffered the damage. 2. The large and common average, being thoſe expences incurred, and damages ſuſtained, for the common good and ſecurity both of the merchandizes and veſſels, conſequently to be borne by the ſhip and cargo, and to be regulated upon the whole. Of this number are the goods or money given for the ranſom of the ſhip and cargo, things thrown overboard for the ſafety of the ſhip, the expences of unloading for entering into a river or harbour, and the proviſions and hire of the ſailors when the ſhip is put under an embargo. 3. The ſmall averages, which are the expences for towing and piloting the ſhip out of or into harbours, creeks or rivers, one-third of which muſt be charged to the ſhip, and two-thirds to the cargo.

AVERAGE is more particularly uſed for a certain contribution that merchants make proportionably to their loſſes, who have had their goods caſt into the ſea in the time of a tempeſt. It alſo ſignifies a ſmall duty which thoſe merchants, who ſend goods in another man's ſhip, pay to the maſter for his care of them over and above the freight. Hence it is expreſſed in the bills of lading, paying ſo much freight for the ſaid goods, with primage and *average* accuſtomed.

AVERDUPOIS. See AVOIRDUPOIS.

AVERNUS, a lake of Campania in Italy, near Baiæ, famous among the ancients for its poiſonous qualities. It is deſcribed by Strabo as lying within the Lucrine bay, deep and darkſome, ſurrounded with ſteep banks that hang threatening over it, and only acceſſible by the narrow paſſage through which you ſail in. Black aged groves ſtretched their ~~boughs over~~ the watry abyſs, and with impenetrable foliage excluded almoſt every ray of wholeſome light; mephitic vapours aſcending from the hot bowels of the earth, being denied free paſſage to the upper atmoſphere, floated along the ſurface in poiſonous miſts. Theſe circumſtances produced horrors fit for ſuch gloomy deities; a colony of Cimerians, as well ſuited to the rites as the place itſelf, cut dwellings in the boſom of the ſurrounding hills, and officiated as prieſts of Tartarus. Superſtition always delighting in dark ideas, early and eagerly ſeized upon this ſpot, and hither ſhe led her trembling votaries to celebrate her diſmal orgies; here ſhe evoked the manes of departed heroes—here ſhe offered ſacrifices to the gods of hell, and attempted to dive into the ſecrets of futurity. Poets enlarged upon the popular theme, and painted its awful ſcenery with the ſtrongeſt colours of their art. Homer brings Ulyſſes to Avernus, as to the mouth of the infernal abodes; and in imitation of the Grecian bard, Virgil conducts his hero to the ſame ground. Whoever ſailed thither, firſt did ſacrifice; and endeavoured to propitiate the infernal powers, with the aſſiſtance of ſome prieſts who attended upon the place, and directed the myſtic performance. Within, a fountain of pure water broke out juſt over the ſea, which was fancied to be a vein of the river Styx; near this fountain was the oracle, and the hot waters frequent in thoſe parts were ſuppoſed to be branches of the burning Phlegethon. The poiſonous effluvia from this lake were ſaid to be ſo ſtrong, that they proved fatal to birds endeavouring to fly over it. Virgil aſcribes the exhalation not to the lake itſelf, but to the cavern near it, which is called *Avernus*, or *Cave of the Sibyl*, and through which the poets feigned a deſcent to hell. Hence the proper name of the lake is *Lacus Averni*, the "lake near the cavern," as it is called by ſome ancient authors.

The holineſs of theſe ſhades remained unimpeached for many ages: Hannibal marched his army to offer incenſe at this altar; but it may be ſuſpected he was led to this act of devotion rather by the hopes of ſurpriſing the garriſon of Puteoli, than by his piety. After a long reign of undiſturbed gloom and celebrity, a ſudden glare of light was let in upon Avernus; the horrors were diſpelled, and with them vaniſhed the ſanctity of the lake; the axe of Agrippa brought its foreſt to the ground, diſturbed its ſleepy waters with ſhips, and gave room for all its malignant effluvia to eſcape. The virulence of theſe exhalations, as deſcribed by ancient authors, has appeared ſo very extraordinary, that modern writers, who know the place in a cleared ſtate only, charge theſe accounts with exaggeration: but Mr Swinburn thinks them entitled to more reſpect; for even now, he obſerves, the air is feveriſh and dangerous, as the jaundiced faces of the vine-dreſſers, who have ſucceeded the Sibyls and the Cimmerians in the poſſeſſion of the temple, moſt ruefully teſtify. Boccaccio relates, that during his reſidence at the Neapolitan court, the ſurface of this lake was ſuddenly covered with dead fiſh, black and ſinged, as if killed by ſome ſubaqueous eruption of fire.

At preſent the lake abounds with tench; the Lucrine with eels. The change of fortune in theſe lakes, is ſingular: In the ſplendid days of imperial Rome the Lucrine was the choſen ſpot for the brilliant parties of pleaſure of a voluptuous court; now, a ſlimy bed of ruſhes covers the ſcattered pools of this once

Averrhoa. beautiful sheet of water; while the once dusky Avernus is clear and serene, offering a most alluring surface and charming scene for similar amusements. Opposite to the temple is a cave usually styled the Sybil's grotto; but apparently more likely to have been the mouth of a communication between Cumæ and Avernus, than the abode of a prophetess; especially as the sybil is positively said by historians to have dwelt in a cavern under the Cumean citadel.

AVERRHOA in botany: A genus of the decandria order, belonging to the pentagynia class of plants; and in the natural method ranking under the 14th order, *Gruinales* The calyx has 5 leaves, the petals are 5, opening at top; and the apple or fruit is pentagonous, and divided into 5 cells. There are 3 species, viz. the blimbi, the carambola, and the acida, all natives of the Indies.

Phil. Transf. vol. 75. part 2. The second of these, the carambola, called in Bengal the *camrue* or *camrunga*, is remarkable for possessing a power somewhat similar to those species of Mimosa which are termed *sensitive plants;* its leaves, on being touched, moving very perceptibly. In the mimosa the moving faculty extends to the branches; but from the hardness of the wood, this cannot be expected in the camrunga. The leaves are alternately pinnated, with an odd one; and in their most common position in the day-time are horizontal, or on the same plane with the branch from which they come out. On being touched, they move themselves downward, frequently in so great a degree that the two opposite almost touch one another by their under sides, and the young ones sometimes either come into contact or even pass each other. The whole of the leaves of one pinna move by striking the branch with the nail of the finger or other hard substance; or each leaf can be moved singly, by making an impression that shall not extend beyond that leaf. In this way the leaves of one side of the pinna may be made to move, one after another, whilst the opposite continue as they were; or you may make them move alternately, or in short in any order you please, by touching in a proper manner the leaf you wish to put in motion. But if the impression, although made on a single leaf, be strong, all the leaves on that pinna, and sometimes on the neighbouring ones, will be affected by it. Notwithstanding this apparent sensibility of the leaf, however, large incisions may be made in it with a pair of sharp scissars, without occasioning the smallest motion; nay, it may even be cut almost entirely off, and the remaining part still continue unmoved, when by touching the wounded leaf with the finger or point of the scissars, motion will take place as if no injury had been offered. The reason of this is, that although the leaf be the ostensible part which moves, it is in fact entirely passive, and the petiolus is the seat both of sense and action: for although the leaf may be cut in pieces, or squeezed with great force, provided its direction be not changed without any motion being occasioned; yet if the impression on the leaf be made in such a way as to affect the petiolus, the motion will take place. When, therefore, it is wanted to confine the motion to a single leaf, you either touch it so as only to affect its own petiolus, or without meddling with the leaf, touch the petiolus with any small-pointed body, as a pin or knife. By compressing the universal petiolus near the place where a partial one comes out, the leaf moves in a few seconds in the same manner as if you had touched the partial petiolus. Averrhoa.

Whether the impression be made by puncture, percussion, or compression, the motion does not instantly follow: generally several seconds intervene, and then it is not by a jirk, but regular and gradual. Afterwards, when the leaves return to their former situation, which is commonly a quarter of an hour or less, it is in so slow a manner as to be almost imperceptible.

On sticking a pin into the universal petiolus at its origin, the leaf next it, which is always on the outer side, moves first; then the first leaf on the opposite side, next the second leaf on the outer, and so on. But this regular progression seldom continues throughout; for the leaves on the outer side of the pinna seem to be affected both more quickly, and with more energy, than those of the inner; so that the fourth leaf on the outer side frequently moves as soon as the third on the inner; and sometimes a leaf, especially on the inner side, does not move at all, whilst those above and below it are affected in their proper time. Sometimes the leaves at the extremity of the petiolus move sooner than several others which were nearer the place where the pin was put in. On making a compression with a pair of pincers on the universal petiolus, between any two pair of leaves, those above the compressed part, or nearer the extremity of the petiolus, move sooner than those under it, or nearer the origin; and frequently the motion will extend upwards to the extreme leaf, whilst below it perhaps does not go farther than the nearest pair. If the leaves happen to be blown by the wind against one another, or against the branches, they are frequently put in motion; but when a branch is moved gently, either by the hand or the wind, without striking against any thing, no motion of the leaves takes place.

When left to themselves in the day-time, shaded from the sun, wind, rain, or any disturbing cause, the appearance of the leaves is different from that of other pinnated plants. In the last a great uniformity subsists in the respective position of the leaves on the pinna; but here some will be seen on the horizontal plane, some raised above it, and others fallen under it; and in an hour or so, without any order or regularity which can be observed, all these will have changed their respective positions.

Cutting the bark of the branch down to the wood, and even separating it about the space of half an inch all around, so as to stop all communication by the vessels of the bark, does not for the first day affect the leaves, either in their position or their aptitude for motion. In a branch, which was cut through in such a manner as to leave it suspended only by a little of the bark no thicker than a thread, the leaves next day did not rise so high as the others; but they were green and fresh, and, on being touched, moved, but in a much less degree than formerly.

After-sun-set the leaves go to sleep, first moving down so as to touch one another by their under sides; they therefore perform rather more extensive motion at night of themselves than they can be made to do in the day-time by external impressions. With a convex lens the rays of the sun may be collected on a leaf, so as as to burn a hole in it, without occasioning any motion. But upon trying the experiment on the petiolus, the motion is as quick as if from strong percussion, although the rays be not so much concentrated as to cause pain when applied in the same degree on the back of the hand. The leaves move very fast from the electrical shock, even although a very gentle one.

AVERROES, one of the most subtile philosophers that ever appeared among the Arabians, flourished at the end of the 11th and beginning of the 12th century. He was the son of the high-priest and chief judge of Corduba in Spain: he was educated in the university of Morocco; and studied natural philosophy, medicine, mathematics, law, and divinity. After the death of his father, he enjoyed his posts; but notwithstanding his being exceeding rich, his liberality to men of letters in necessity, whether they were his friends or his enemies, made him always in debt. He was afterwards stripped of all his posts, and thrown into prison, for heresy; but the oppressions of the judge who succeeded him, caused him to be restored to his former employments.

He died at Morocco in the year 1206. He was excessively fat, though he eat but once a-day. He spent all his nights in the study of philosophy; and when he was fatigued, amused himself with reading poetry or history. He was never seen to play at any game, or to partake in any diversion. He was extremely fond of Aristotle's works, and wrote commentaries on them; whence he was styled, *The commentator*, by way of eminence. He likewise wrote a work on the whole art of physic, and many amorous verses; but when he grew old, he threw these last into the fire. His other poems are lost, except a small piece, in which he says, "That when he was young, he acted against his reason; but that when he was in years, he followed its dictates:" upon which he utters this wish; "Would to God I had been born old, and that in my youth I had been in a state of perfection!" As to religion, his opinions were, that Christianity is absurd; Judaism, the religion of children; Mahometanism, the religion of swine.

AVERROISTS, a sect of peripatetic philosophers, who appeared in Italy some time before the restoration of learning, and attacked the immortality of the soul. They took their denomination from AVERROES, the celebrated interpreter of Aristotle (see the preceding article), from whom they borrowed their distinguishing doctrine.

The Averroists who held the soul was mortal, according to reason or philosophy, yet pretended to submit to the Christan theology, which declares it immortal. But the distinction was held suspicious; and this divorce of faith from reason was rejected by the doctors of that time, and condemned by the last council of the Lateran under Leo X.

AVERRUNCI (DEI); certain gods, whose business it was, according to the Pagan theology, to avert misfortunes. Apollo and Hercules were of the number of these gods, among the Greeks; and Castor and Pollux, among the Romans.

AVERSA, a town of Italy, in the kingdom of Naples, with a bishop's see. It is situated in a very fine plain, in E. Long. 14. 20. N. Lat. 41. 0.

AVERSION, according to Lord Kames, is opposed to *affection*, and not to *desire*, as it commonly is. We have an affection to one person; we have an aversion to another: the former disposes us to do good to its object, the latter to do ill.

AVERTI, in horsemanship, is applied to a regular step or motion enjoined in the lessons. In this sense they say *pas averte*, sometimes *pas ecouté*, and *pas d'ecole*, which all denote the same. The word is mere French, and signifies *advised*.

AVES, one of the Caribbee islands, 451 miles south of Porto Rico, with a good harbour for careening of ships. It is so called from the great number of birds that frequent it. There is another of the same name lying to the northward of this, in N. Lat. 15. 0.; and a third near the eastern coast of Newfoundland, in N. Lat. 50. 5.

Aves, *Birds*, the name of Linnæus's second class of animals. See ZOOLOGY, n° 8. and ORNITHOLOGY.

AVESBURY, (Robert), an English historian, of whom little more is known than that he was keeper of the registry of the court of Canterbury in the reign of Edward III. and consequently that he lived in the 14th century. He wrote, *Memorabilia gesta magnifici regis Angliæ domini Edwardi tertii post conquestum, procerumque; tactis primitus quibusdam gestis de tempore patris sui domini Edwardi secundi, quæ in regnis Angliæ, Scotiæ, et Franciæ, ac in Aquitannia et Britannia, non humana sed Dei potentia, contigerunt, per Robertum de Avesbury.* This history ends with the battle of Poictiers, about the year 1356. It continued in manuscript till the year 1720, when it was printed by the industrious Thomas Hearne at Oxford, from a manuscript belonging to Sir Thomas Seabright. It is now become very scarce.

AVEZZANO, a town of Italy in the kingdom of Naples in the Farther Abruzzo. It is built on an almost imperceptible declivity, one mile from the lake of Celano, to which an avenue of poplars leads from the baronnial castle. This edifice stands at a little distance from the town, is square, and flanked with towers; it was erected by Virginio Orsini, to which family this and many other great lordships belonged, before they were wrested from them in times of civil war, and transferred to the Colonnas. Avezzano was founded in 860, and contains 2700 inhabitants, and two religious communities within its walls, which are indeed in a ruinous condition. The houses are in general mean; but there are some large buildings and opulent families of the class of gentlemen, not possessed of fees held *in capite*.

AGUE, a territory of Normandy in France, which gives title to a viscount. It extends from Falaise and Argenton as far as the sea, between the rivers Dives, Vie, and Tougues. The arable land is stiff, and produces but little good corn: but they sow sainfoin; which succeeds so well that they have five good crops successively: they likewise sow flax and hemp; and have a vast quantity of apples, with which they make cyder. Horses are bred here in great numbers; and the inhabitants fatten the oxen which come from Poictou and Brittany.

AUGEAS, in fabulous history, was king of Elis, and particularly famed for his stable, which contained 3000 oxen, and had not been cleaned for 30 years. Hercules was desired to clear away the filth from this stable in one day; and Augeas promised, if he performed

formed it, to give him a tenth part of the cattle. This taſk Hercules is ſaid to have executed by turning the courſe of the river Alpheus through the ſtable; when Augeas refuſing to ſtand by his engagement, Hercules ſlew him with his arrows, and gave his kingdom to Phyleus his ſon, who had ſhown an abhorrence of his farther's inſincerity.

AUGMENT, in grammar, an accident of certain tenſes of Greek verbs, being either the prefixing of a ſyllable, or an increaſe of the quantity of the initial vowels.

AUGMENTATION, in a general ſenſe, is the act of adding or joining ſomething to another with a deſign to render it large.

AUGMENTATION is alſo uſed for the additament or thing added.

AUGMENTATION was alſo the name of a court erected 27 Hen. VIII. ſo called from the augmentation of the revenues of the crown, by the ſuppreſſion of religious houſes; and the office ſtill remains, wherein there are many curious records, tho' the court has been diſſolved long ſince.

AUGMENTATION, in heraldry, are additional charges to a coat-armour, frequently given as particular marks of honour, and generally borne either in the eſcutcheon or a conton; as have all the baronets of England, who have borne the arms of the province of Ulſter in Ireland.

AUGRE, or AWGRE, an inſtrument uſed by carpenters and joiners to bore large round holes; and conſiſting of a wooden handle, and an iron blade terminated at bottom with a ſteel bit.

AUGSBURG, a city of Germany, capital of the circle of Suabia, ſeated near the confluence of the Ardech and Lech, in one of the moſt beautiful plains that can be imagined. It is one of the largeſt and handſomeſt cities of the empire; but the fortifications are after the old manner, and very irregular; the ſtreets are broad and ſtraight; the houſes moſtly of timber, plaſtered and whitened without, or adorned with paintings; the reſt are of free-ſtone; the churches and fountains are generally ornamented with fine figures of braſs. Many of the churches are ſtately, and adorned within with curious workmanſhip and paintings. That part of the city erected by the noble family of the Fuggers, who are lords of the adjacent country, conſiſts of ſeveral ſtreets croſs-wiſe, containing 106 houſes: the poor people that inhabit them are maintained by an annual penſion. Its magnificent town-houſe is little inferior to that of Amſterdam, it being a vaſt ſquare ſtone-building, with a marble portico; at the top of the front, within the pediment, is a large ſpread eagle, holding a ſceptre and globe in its talons, of braſs, gilt, ſaid to weigh 2200 weight; the great portal is of a very beautiful reddiſh marble; over which is a balcony of the ſame colour, ſupported by two pillars of white marble; over the gate there are two large griffins of braſs; moſt of the rooms are wainſcotted and ceiled with very fine timber: the great hall is very magnificent, and paved with marble; it is 110 feet long, 58 broad, and 52 high, and its roof is ſupported by eight columns of red marble; the ceiling of the upper wall is of very curious workmanſhip of poliſhed aſh, conſiſting of compartments, the ſquares and pannels of which are enriched with gilded ſculptures, and filled with pictures and other ornaments; this is likewiſe ſupported by eight pillars with baſes and chapiters of braſs: the other rooms are handſomely adorned with very fine paintings.

In the ſquare, near the town-houſe, is the fountain of Auguſtus, which is a marble baſon, ſurrounded with iron balluſtrados finely wrought: at the four corners are four braſs ſtatues as big as the life, two of which are women and two men; in the middle of the baſon is a pedeſtal, at the foot of which are four large ſphinxes ſquirting water out of their breaſts; a little above theſe are four infants holding four dolphins in their arms, which pour water out of their mouths; and over theſe infants are feſtoons of pine-apples all of braſs; upon the pedeſtal is the ſtatue of Auguſtus as large as the life. The fountain moſt remarkable next to this is that of Hercules, which is a hexagon baſon with ſeveral braſs figures, particularly Hercules engaging the hydra. Another curioſity is the ſecret gate, which was contrived to let in perſons ſafely in time of war: it has ſo many engines and diviſions with gates and keys, and apartments for guards at ſome diſtance from each other, where paſſengers are examined, that it is impoſſible for the town to be ſurpriſed this way; the gates are bolted and unbolted, opened and ſhut, by unſeen operators, inſomuch that it looks like enchantment. The water-towers are alſo very curious, of which there are three ſeated on a branch of the river Lech, which runs through the city in ſuch a torrent as to drive many mills, which work a number of pumps that raiſe the water in large leaden pipes to the top of the towers; one of theſe ſends water to the public fountains, and the reſt to near 1000 houſes in the city.

The Lutherans have a college here, which is a vaſt ſquare building, with a fine clock on the top of the front. In this there are ſeven different claſſes, a hall for public diſputations, and a theatre for dramatic repreſentation. The cathedral is a large, gloomy, Gothic building, with two ſpire ſteeples; it is adorned with paintings upon whimſical ſubjects, and has a great gate all of braſs, over which are ſeveral ſcripture paſſages well repreſented in baſſo relievo. The Jeſuits had a ſplendid college here, with a church full of gilding, painting, and carving; and a fine library. Tho' half the inhabitants are Lutherans, there are a great many Popiſh proceſſions. There are no Jews in the town, nor are they ſuffered to lie there; but they inhabit a village at about a league diſtance, and pay ſo much an hour for the liberty of trading in the day-time. The Benedictine abbey is a vaſt Gothic building, the ceiling of which is ſaid to be the higheſt in Germany, and overlooks all the reſt of the churches; it is adorned with ſeveral ſtatues, and has one very grand altar. The church of St Croix is one the handſomeſt in Augſburg for architecture, painting, ſculpture, gilding, and a fine ſpire.

The inhabitants look upon Auguſtus Cæſar as the founder of the town: it is true, that that emperor ſent a colony there; but the town was already founded, though he gave it the name of *Auguſta Vindelicorum*. Augſburg, indeed, is one of the oldeſt towns in Germany, and one of the moſt remarkable of them, as it is there and at Nuremberg that you meet with the oldeſt marks of German art and induſtry. In the 14th and 15th centuries, the commerce of this town was the

the most extensive of any part of south Germany, and contributed much to the civilization of the country by the works of art and variety of necessaries to the comfort and convenience of life which it was the means of introducing. Many things originated in this town which have had a great influence on the happiness of mankind. Not to mention the many important diets of the empire held here; here, in 952, did a council confirm the order for the celibacy of priests; here, in 1530, was the confession of faith of the Protestants laid before the emperor and other estates of Germany; and here, in 1555, was signed the famous treaty of peace, by which religious liberty was secured to Germany.

Though the Protestants were very powerful at Augsburg, they could not keep their ground; for the Bavarians drove them from thence: but Gustavus Adolphus restored them again in 1632; since which time they have continued there, and share the government with the Catholics. In 1703, the elector of Bavaria took the city after a siege of seven days, and demolished the fortifications: however, the battle of Hochsted restored their liberty, which they yet enjoy under the government of their own magistrates, the bishop having no temporal dominion in the city. The chapter is composed of persons of quality, who are to bring proofs of their nobility. The canons have a right of electing their own bishop, who is a sovereign, in the same manner as several other of the German bishops.

The police of the place is very good; and though the town has no territory, it has no debts. Augsburg is, however, no longer what it was. It no longer has a Fugger and a Welser in it to lend the emperor millions. In this large and handsome town, formerly one of the greatest trading towns in Germany, there are no merchants at present to be found who have capitals of more than L. 20,000. The others, most of whom must have their coaches, go creeping on with capitals of L. 3,000 or L. 4,000, and do the business of brokers and commissioners. Some houses, however, carry on a little banking trade; and the way through Tyrol and Graubundten occasions some little exchange between this place and Germany. After these brokers and doers of business by commission, the engravers, statuaries, and painters, are the most reputable of the labouring part of the city. Their productions, like the toys of Nuremberg, go every where. There are always some people of genius amongst them; but the small demand for their art affords them so little encouragement, that to prevent starving they are mostly confined to the small religious works which are done elsewhere by Capuchin monks. They furnish all Germany with little pictures for prayer books, and to hang in the citizens houses. There is an academy of arts instituted here under the protection of the magistrates: the principle aim of which is to produce good mechanics, and preserve the manufactures of the city.

This town, which is 9½ miles in circumference, contains, according to Mr Riesbeck, hardly 30,000 inhabitants; but Mr Nicolai makes them about 35,000 and says there are 28,000 houses.

The city has its drinking water from the river Lech, which runs at some distance from it; and the aqueducts which convey the water are much to be admired. As the court of Bavaria has it in its power to cut off this indispensable necessary, by threatening the town with doing so, it often lays it under contribution. But as it has, besides this, other means of keeping the high council in a state of dependance, to secure itself from this oppression, the city seeks the emperor's protection, upon whom it makes itself as dependant on the other side, so as to be indeed only a ball which both courts play with. The emperor's minister to the circle of Suabia generally resides here, and by so doing secures to his court a perpetual influence. There are always Austrian and Prussian recruiting parties quartered here, and the partiality of the government to the former is very remarkable. In the war of 1756, the citizens were divided into equal parties for the two courts. The Catholics considered the emperor as their god, and the Protestants did the same by the king of Prussia. The flame of religion had almost kindled a bloody civil war amongst them.—The bishop takes his name from this town, but resides at Dillingen. He has an income of about L. 20,000 *per annum*. As a proof of the catholicism of this place, the Pope throughout his whole progress met no where with such honours as he did here. This he owed to his friends the Jesuits, who have still great influence. E. Long. 10. 58. N. Lat. 48. 24.

Augsburg Confession, denotes a celebrated confession of faith drawn up by Luther and Melancthon, on behalf of themselves and other ancient reformers, and presented in 1530 to the emperor Charles V. at the diet of Augusta or Augsburg, in the name of the evangelic body. This confession contains 28 chapters; of which the greatest part is employed in representing, with perspicuity and truth, the religious opinions of the Protestants, and the rest in pointing out the errors and abuses that occasioned their separation from the church of Rome.

AUGUR, an officer among the Romans appointed to foretel future events, by the chattering, flight, and feeding, of birds. There was a college or community of them, consisting originally of three members with respect to the three Luceres, Rhamnenses, and Tatienses: afterwards the number was increased to nine, four of whom were patricians and five plebeians. They bore an augural staff or wand, as the ensign of their authority; and their dignity was so much respected, that they were never deposed, nor any substituted in their place, though they should be convicted of the most enormous crimes. See Augury.

AUGURAL, something relating to the augurs.—The augural instruments are represented on several ancient medals.

Augural Supper, that given by a priest on his first admission into the order, called also by Varro *Adjicialis*.

Augural Books, those wherein the discipline and rules of augury were laid down.

AUGURALE, the place in a camp where the general took auspicia. This answered to the *Auguratorium* in the city.

Augurale is also used in Seneca for the ensign or badge of an augur, as the *lituus*.

AUGURATORIUM, a building on the Palatine mount where public auguries were taken.

AUGURY, in its proper sense, the art of foretelling future events by observations taken from the chattering, ſinging, feeding, and flight of birds; though it was uſed by ſome writers in a more general ſignification, as compriſing all the different kinds of divination.

Augury was a very ancient ſuperſtition. We know from Heſiod, that huſbandry was in part regulated by the coming or going of birds; and moſt probably it had been in uſe long before his time, as aſtronomy was then in its infancy. In proceſs of time, theſe animals ſeem to have gained a greater and very wonderful authority, till at laſt no affair of conſequence, either of public or private concern, was undertaken without conſulting them. They were looked upon as the interpreters of the gods; and thoſe who were qualified to underſtand their oracles were held among the chief men in the Greek and Roman ſtates, and became the aſſeſſors of kings, and even of Jupiter himſelf. However abſurd ſuch an inſtitution as a college of Augurs may appear in our eyes, yet, like all other extravagant inſtitutions, it had in part its origin from nature. When men conſidered the wonderful migration of birds, how they diſappeared at once, and appeared again at ſtated times, and could give no gueſs where they went, it was almoſt natural to ſuppoſe, that they retired ſomewhere out of the ſphere of this earth, and perhaps approached the ethereal regions, where they might converſe with the gods, and thence be enabled to predict events. It was almoſt natural for a ſuperſtitious people to imagine this; at leaſt to believe it, as ſoon as ſome impoſtor was impudent enough to aſſert it. Add to this, that the diſpoſition in ſome birds to imitate the human voice, muſt contribute much to the confirmation of ſuch a doctrine. This inſtitution of augury ſeems to have been much more ancient than that of aruſpicy; for we find many inſtances of the former in Homer, but not a ſingle one of the latter, tho' frequent mention is made of ſacrifices in that author. From the whole of what has been obſerved, it ſeems probable, that natural augury gave riſe to religious augury, and this to aruſpicy, as the mind of man makes a very eaſy tranſition from a little truth to a great deal of error.

Stillingfleet's *Calendar of Flora.*

A paſſage in Ariſtophanes gave the hint for theſe obſervations. In the Comedy of the Birds, he makes one of them ſay this: 'The greateſt bleſſings which can happen to you, mortals, are derived from us; firſt, we ſhow you the ſeaſons, viz. Spring, Winter, Autumn. The crane points out the time for ſowing, when ſhe flies with her warning notes into Egypt; ſhe bids the ſailor hang up his rudder and take his reſt, and every prudent man provide himſelf with winter-garments. Next the kite appearing, proclaims another ſeaſon, *viz.* when it is time to ſhear his ſheep. After that the ſwallow informs you when it is time to put on ſummer clothes. We are to you, (adds the chorus), Ammon, Dodona, Apollo: for, after conſulting us, you undertake every thing; merchandize, purchaſes, marriages, &c.' Now, it ſeems not improbable, that the ſame tranſition was made in the ſpeculations of men which appears in the poet's words; and that they were eaſily induced to think, that the ſurpriſing foreſight of birds, as to the time of migration, indicated ſomething of a divine nature in them; which opinion Virgil, as an Epicurean, thinks fit to enter his proteſt againſt, when he ſays,

Haud equidem credo, quia ſit divinitus illis
Ingenium.

But to return to Ariſtophanes. The firſt part of the chorus, from whence the fore-cited paſſage is taken, ſeems, with all its wildneſs, to contain the fabulous cant, which the augurs made uſe of in order to account for their impudent impoſitions on mankind. It ſets out with a coſmogony; and ſays, That in the beginning were Chaos and Night, and Erebus and Tartarus: That there was neither water, nor air, nor ſky: That Night laid an egg, from whence, after a time, Love aroſe: That Love, in conjunction with Erebus, produced a third kind; and that they were the firſt of the immortal race, &c.

AUGUST, (*Auguſtus*), in a general ſenſe, ſomething majeſtic, venerable, or ſacred. The appellation was firſt conferred by the Roman ſenate upon Octavius, after his being confirmed by them in the ſovereign power. It was conceived as expreſſing ſomething divine, or elevated above the pitch of mankind, being derived from the verb *augeo*, "I increaſe," *tanquam ſupra humanam ſortam auctus*. See AUGUSTUS.

AUGUST, in chronology, the eighth month of our year, containing 31 days. Auguſt was dedicated to the honour of Auguſtus Cæſar, becauſe, in the ſame month, he was created conſul, thrice triumphed in Rome, ſubdued Egypt to the Roman empire, and made an end of civil wars: being before called *Sextilis*, or the ſixth month from March.

AUGUSTA, the capital of the ſtate of Georgia, in North America, on the river Savannah, 134 miles from the ſea, ſeated on a fine plain, it contains about 200 houſes, and from the advantage of its central ſituation between the upper and lower counties is riſing faſt into importance.

AUGUSTA, or *Auſta*, an iſland in the Adriatic ſea, on the coaſt of Dalmatia, near Raguſa, ſubject to Venice. E. Long. 17. 50. N. Lat. 42. 35.

AUGUSTA Auſciorum, a town of Aquitania. In the middle age, it took the name of the people, *Auſci*; and is now called *Auch*, the capital of Gaſcony.

AUGUSTA Emerita, a town of Luſitania on the river Anas, the capital of the province; a colony of the Emeriti, or ſuch ſoldiers as had ſerved out their legal time, were men of experience, or had received marks of favour. The colony was founded by Auguſtus; and is now called *Merida*, a city of Spain, in Eſtremadura, on the river Guadiana. See MERIDAN.

AUGUSTA Prætoria, a town and colony of Gallia Ciſalpina, and capital of the Salaſſi; ſeated at the foot of the Alps Graiæ on the Duria. Now *Aouſte* in Piedmont. See AOUSTE.

AUGUSTA Rauracorum, a town of Gallia Belgica; now a ſmall village called *Auguſt*, at the bend of the Rhine northwards, but from the ruins, which are ſtill to be ſeen, appears to have been a conſiderable colony, at the diſtance of ſix miles from Baſil to the eaſt.

AUGUSTA Sueſſonum, a town of Gallia Belgica on the Axona. Now *Soiſſons*, on the river Aiſne, in the Iſle of France. See SOISSONS.

AUGUSTA Taurinorum, a town of the Taurini at the foot of the Alps where the Duria Minor falls into the Po; now *Turin*, the capital of Piedmont.

AUGUSTA Treba, a town of the Æqui, near the ſprings of the river Anio in Italy; now *Trevi*, in Umbria, or in the eaſt of the Campagna di Roma.

Augusta Trevirorum, a town of the Treviri, a people inhabiting between the Rhine and the Meuse, but especially about the Moselle; now *Triers*, or *Treves*, in the circle of the Lower Rhine on the Moselle.

Augusta Vindelicorum, a town of the Licates on the Licus; called by Tacitus a noble colony of *Rhætia*; now *Augsburg*, capital of Suabia.

Augusta Historia, is the history of the Roman emperors from the time of Adrian to Carinus, that is, from the year of our Lord 157 to 285, composed by six Latin writers, Æl. Spartianus, Julius Capitolinus, Æl. Lampridius, Vulcatius Gallicanus, Trebellius Pollio, and Flavius Vopiscus.

AUGUSTALES, in Roman antiquity, an epithet given to the flamens or priests appointed to sacrifice to Augustus after his deification; and also to the ludi or games celebrated in honour of the same prince on the fourth of the ides of October.

AUGUSTALIA, a festival instituted by the Romans in honour of Augustus Cæsar, on his return to Rome, after having settling peace in Sicily, Greece, Syria, Asia, and Parthia; on which occasion they likewise built an altar to him, inscribed *Fortunæ reduci*.

AUGUSTALIS PRÆFECTUS, a title peculiar to a Roman magistrate who governed Egypt, with a power much like that of a proconsul in other provinces.

AUGUSTAN CONFESSION. See AUGSBURG *Confession*.

AUGUSTIN, or AUSTIN, (St), the first archbishop of Canterbury, was originally a monk in the convent of St Andrew at Rome, and educated under St Gregory, afterwards Pope Gregory I. by whom he was dispatched into Britain with 40 other monks of the same order, about the year 596, to convert the English Saxons to Christianity. They landed in the isle of Thanet; and having sent some French interpreters to king Ethelbert with an account of their errand, the king gave them leave to convert as many of his subjects as they could, and assigned their place of residence at Dorovernum, since called *Canterbury*; to which they were confined till the king himself was converted, whose example had a powerful influence in promoting the conversion of his subjects; but though he was extremely pleased at their becoming Christians, he never attempted to compel them. He dispatched a priest and a monk to Rome, to acquaint the pope with the success of his mission, and to desire his resolution of certain questions. These men brought back with them a pall, and several books, vestments, utensils, and ornaments for the churches. His holiness, by the same messengers, gave Augustin directions concerning the settling of episcopal sees in Britain; and ordered him not to pull down the idol-temples, but to convert them into Christian churches; only destroying the idols, and sprinkling the place with holy water, that the natives, by frequenting the temples they had been always accustomed to, might be the less shocked at their entrance into Christianity. Augustin resided principally at Canterbury, which thus became the metropolitan church of England; and having established bishops in several of the cities, he died on the 26th of May, 607. The Popish writers ascribe several miracles to him. The observation of the festival of St Augustin was first enjoined in a synod held under Cuthbert archbishop of Canterbury, and afterwards by the pope's bull in the reign of king Edward III.

AUGUSTINE (St), an illustrious father of the church, was born at Thagaste, a city Numidia, on the 13th of November 354. His father, a burgess of that city, was called *Patricius*; and his mother, *Monica*, who being a woman of great virtue, instructed him in the principles of the Christian religion. In his early youth he was in the rank of the catechumens; and falling dangerously ill, earnestly desired to be baptized; but the violence of the distemper ceasing, his baptism was delayed. His father, who was not yet baptized, made him study at Thagaste, Madaura, and afterwards at Carthage. Augustine having read Cicero's books of philosophy, began to entertain a love for wisdom, and applied himself to the study of the holy scriptures; nevertheless, he suffered himself to be seduced by the Manicheans. At the age of 19, he returned to Thagaste, and taught grammar, and also frequented the bar; he afterwards taught rhetoric at Carthage with applause. The insolence of the scholars at Carthage made him take a resolution to go to Rome, tho' against his mother's will. Here also he had many scholars; but disliking them, he quitted Rome, and settled at Milan, and was chosen public professor of rhetoric in that city. Here he had opportunities of hearing the sermons of St Ambrose, which, together with the study of St Paul's epistles, and the conversion of two of his friends, determined him to retract his errors, and quit the sect of the Manicheans; this was in the 32d year of his age. In the vacation of the year 386, he retired to the house of a friend of his, named *Verecundus*, where he seriously applied himself to the study of the Christian religion, in order to prepare himself for baptism, which he received at Easter, in the year 387. Soon after this, his mother came to see him at Milan, and invite him back to Carthage; but at Ostia, whether he went to embark in order to his return, she died. He arrived in Africa about the end of the year 388; and having obtained a garden-plot without the walls of the city of Hippo, he associated himself with 11 other persons of eminent sanctity, who distinguished themselves by wearing leathern girdles, and lived there in a monastic way for the space of three years, exercising themselves in fasting, praying, study, and meditation, day and night: from hence sprung up the Augustine friars, or eremites of St Augustine, being the first order of mendicants; those of St Jerome, the Carmelites, and others, being but branches of this of St Augustine. About this time, or before, Valerius bishop of Hippo, against his will, ordained him priest: nevertheless, he continued to reside in his little monastery, with his brethren, who, renouncing all property, possessed their goods in common. Valerius, who had appointed St Augustine to preach in his place, allowed him to do it in his presence, contrary to the custom of the churches in Africa. He explained the creed, in a general council of Africa, held in 393. Two years after, Valerius, fearing he might be preferred to be bishop of another church, appointed him his coadjutor or colleague, and caused him to be ordained bishop of Hippo, by Megalus bishop of Calame, then primate of Numidia. St Augustine died the 28th day of August, 430, aged 76 years, having had the misfortune to see his country invaded by the

Vandals, and the city where he was biſhop beſieged for ſeven months.

The works of St Auguſtine make ten volumes; the beſt edition of them is that of Maurin, printed at Antwerp, in 1700. They are but little read at this time, except by the clergy of the Greek church and in the Spaniſh univerſities. The bookſellers of London receive frequent commiſſions for them, and indeed for the moſt of the fathers, from Ruſſia, and alſo from Spain.

AUGUSTINE (St) a fort of North America, on the eaſt coaſt of Cape Florida, ſituated in W. Long. 81. 10. N. Lat. 30. 0. This fort was built by the Spaniards; who were ſcarce well eſtabliſhed there when they were attacked by Sir Francis Drake in 1586, who reduced and pillaged the fort and town adjacent. In 1665, it underwent a ſimilar fate, being attacked by Captain Davis at the head of a conſiderable company of bucaneers. In 1702 an attempt was made by Colonel More to annex St Auguſtine to the Britiſh dominions. He inveſted it with only 500 Engliſh and 700 Indians; which ſmall force, however, would have been ſufficient to reduce the place, had not ſuccours arrived when it was on the point of ſurrendering. Even then, it is thought that he might have defeated the reinforcement which arrived; but he choſe to raiſe the ſiege, and retire with precipitation. In 1740, another unſucceſsful attempt was made on this fort by general Oglethorpe: it was, however, together with the whole country of Florida, ceded to Great Britain by the treaty of Paris in 1763; but has ſince been reſtored to Spain by the treaty of peace 1783.

AUGUSTINE, a cape of South America. W. Long. 35. 4. S. Lat. 8. 30.

AUGUSTINS, or AUGUSTINIANS, an order of religious; thus called from St Auguſtin, whoſe rule they obſerve. The Auguſtins, popularly alſo called Auſtin friers, were originally hermits, whom pope Alexander IV. firſt congregated into one body, under their general Lanfranc, in 1256. Soon after their inſtitution, this order was brought into England, where they had about thirty-two houſes at the time of their ſuppreſſion.

The Auguſtins are clothed in black, and make one of the four orders of mendicants. From theſe aroſe a reform, under the denomination of *bare-foot Auguſtins*, or *Minorites*, or *Friers minor*.

There are alſo canons regular of St Auguſtin, who are clothed in white, excepting their cope, which is black. At Paris they are known under the denomination of *religious of* GENEVIEVE; that abbey being the chief of the order. There are alſo nuns and canoneſſes, who obſerve the rules of St Auguſtin.

AUGUSTINIANS are alſo thoſe divines who maintain, on the authority of St Auguſtin, that GRACE is effectual from its nature, abſolutely and morally, and not relatively and gradually. They are divided into rigid and relaxed.

AUGUSTOBONA, a city of the Tricaſſers in ancient Gaul, from whom it was afterwards called *Tricaſſes*, and *Trecaſſæ;* and ſtill further corrupted to *Thracæ or Treci;* whence the modern name *Troyes*, in Champaigne on the Seyne. See TROYES.

AUGUSTODUNUM, the capital of the Ædui, where there was a famous academy or ſchool for the education of youth; now Auſtun, or *Autun*, in the duchy of Burgundy on the Arroux. See AUTUN.

AUGUSTOMAGUS, an ancient town of Gallia Belgica; now *Sentis*, in the Iſle of France. E. Long. 2. 30. N. Lat. 49. 10.

AUGUSTORITUM (anc. geog.), according to ſome authors the capital of the Pictones, afterwards called *Pictavi;* now *Poictiers*. But by Antonine's Itinerary from Burdigala to Argantomagus (or Argenton, as it is interpreted by many), it can be no other but the capital of the Lemovices, now *Limoges*, ſituate between Veſunna of the Petrocorii, or Perigueux, and Argantomagus. E. Long. 1. 22. Lat. 45. 52.

AUGUSTOW, a ſmall but ſtrong town of Poland, in the duchy and Palatinate of Polakia, ſeated on the river Narieu. E. Long. 24. 2. N. Lat. 53. 25.

AUGUSTUS (Fort), a ſmall fortreſs ſeated on a plain at the head of Lochneſs in Scotland, between the rivers Taarf and Orich; the laſt is a conſiderable ſtream, and has over it a ſtone bridge of three arches. The fort conſiſts of four baſtions; within is the governor's houſe, and barracks for 400 men: it was taken by the rebels in 1746, who immediately deſerted it, after demoliſhing what they could. The name of this fort in Erſe is *Kill chuimin*, or *the burial place of the Cummins*. It lies on the road to the Iſle of Sky, which is about 52 miles off; but on the whole way there is not a place fit for the reception of man or horſe.

AUGUSTUS, the appellation conferred upon Cæſar Octavianus, the firſt Roman emperor. See OCTAVIANUS and ROME.

The obſcure name of *Octavianus*, Mr Gibbon obſerves, he derived from a mean family, in the little town of Aricia. It was ſtained with the blood of the proſcription; and he was deſirous, had it been poſſible, to eraſe all memory of his former life. The illuſtrious ſurname of *Cæſar* he had aſſumed, as the adopted ſon of the dictator; but he had too much good ſenſe either to hope to be confounded or to wiſh to be compared with that extraordinary man. It was propoſed in the ſenate, to dignify their miniſter with a new appellation; and after a very ſerious diſcuſſion, that of *Auguſtus* was choſen among ſeveral others, as being the moſt expreſſive of the character of peace and ſanctity, which he uniformly affected. *Auguſtus* was therefore a perſonal, *Cæſar* a family, diſtinction. The former ſhould naturally have expired with the prince on whom it was beſtowed; and however the latter was diffuſed by adoption and female alliance, Nero was the laſt prince who could alledge any hereditary claim to the honours of the Julian line. But at the time of his death, the practice of a century had inſeparably connected thoſe appellations with the imperial dignity, and they have been preſerved by a long ſucceſſion of emperors, Romans, Greeks, Franks, and Germans, from the fall of the republic to the preſent time. A diſtinction was, however, ſoon introduced. The ſacred title of *Auguſtus* was always reſerved for the monarch; the name of *Cæſar* was more freely communicated to his relations; and from the reign of Hadrian at leaſt, was appropriated to the ſecond perſon in the ſtate, who was conſidered as the preſumptive heir of the empire.

AVIARY, a place ſet apart for feeding and propagating birds. It ſhould be ſo large as to give the birds ſome freedom of flight; and turfed, to avoid the appearance of foulneſs on the floor.

Avicena.

AVICENA, or Avicenes, the prince of Arabian philosophers and physicians, was born at Assena, a village in the neighbourthood of Bokhara. His father was from Balkh in Persia, and had married at Bokhara. The first years of Avicenes were devoted to the study of the Koran and the Belle Lettres. He soon showed what he was likely to become afterwards; and the progress he made was so rapid, that when he was but ten years old, he was perfectly intelligent in the most hidden senses of the Koran.

Abou-Abdoullah, a native of Napoulous in Syria, at that time professed philosophy at Bokhara with the greatest reputation. Avicènes studied under him the principles of logic; but soon disgusted with the slow manner of the schools, he set about studying alone, and read all the authors that had written on philosophy, without any other help than that of their commentators. Mathematics had no fewer charms for him; and after reading the first six propositions of Euclid, he got alone to the last, having made himself perfect master of them, and treasured up all of them equally in his memory.

Possessed with an extreme avidity to be acquainted with all sorts of sciences, he likewise devoted himself to the study of medicine. Persuaded that this divine art consists as much in practice as in theory, he sought all opportunities of seeing the sick; and afterwards confessed, that he had learned more from experience than from all the books he had read. He was now in his 16th year, and already was celebrated for being the light of his age. He resolved at this age to resume his studies of philosophy, which medicine had made him neglect: and he spent a year and a half in this painful labour, without ever sleeping all this time a whole night together. If he felt himself oppressed by sleep, or exhausted by study, a glass of wine refreshed his wasted spirits, and gave him new vigour for study; if in spite of him his eyes for a few minutes shut out the light, it then happened to him to recollect and meditate upon all the things that had occupied his thoughts before sleep. At the the age of 21, he conceived the bold design of incorporating, in one work, all the objects of human knowledge; and carried it into execution in an Encyclopedie of 20 volumes, to which he gave the title of the *Utility of Utilities*.

Several great princes had been taken dangerously ill, and Avicènes was the only one that could know their ailments and cure them. His reputation increased daily, and all the kings of Asia desired to retain him in their families.

Mahmud, the son of Sabektekin, the first sultan of the Dynasty of the Samanides, was then the most powerful prince of the east. Imagining that an implicit obedience should be paid by all manner of persons to the injunctions of his will, he wrote a haughty letter to Mamun sultan of Kharazm, ordering him to send Avicènes to him, who was at his court, with several other learned men. Philosophy, the friend of liberty and independence, looks down with scorn on the shackles of compulsion and restraint. Avicènes, accustomed to the most flattering distinctions among the great, could not endure the imperious manner of Mahmud's inviting him to his court, and refused to go there. But the sultan of Kharazm, who dreaded his resentment, obliged the philosopher to depart with others whom that prince had demanded to be sent to him.

Avicènes pretended to obey; but instead of repairing to Gazna, he took the rout of Giorgian. Mahmud, who had gloried in the thoughts of keeping him at his palace, was greatly irritated at his flight. He dispatched portraits done in crayons of this philosopher to all the princes of Asia, with orders to have him conducted to Gazna, if he appeared in their courts. But Avicènes had fortunately escaped the most diligent search after him. He arrived in the capital of Giorgian, where under a disguised name he performed many admirable cures.

Cabous then reigned in that country. A nephew, whom he was extremely fond of, being fallen sick, the most able physicians were called in, and none of them were able to know his ailment, or give him any ease. Avicènes was at last consulted. So soon as he had felt the young prince's pulse, he was confident with himself, that his illness proceeded from a violent love, which he dared not to declare. Avicènes commanded the person who had the care of the different apartments in the palace, to name them all in their respective order. A more lively motion in the prince's pulse, at hearing mentioned one of these apartments, betrayed a part of his secret. The keeper then had orders to name all the slaves that inhabited that apartment. At the name of one of these beauties, the young Cabous could not contain himself; an extraordinary beating of his pulse compleated the discovery of what he in vain desired to keep concealed. Avicènes, now fully assured that this slave was the cause of this prince's illness, declared, that she alone had the power to cure him.

The Sultan's consent was necessary, and he of course was curious to see his nephew's physician. He had scarce looked at him, when he knew in his features those of the crayoned portrait sent him by Mahmud; but Cabous, far from forcing Avicènes to repair to Gazna, retained him for some time with him, and heaped honours and presents on him.

This philosopher passed afterwards into the court of Nedjmeddevle, Sultan of the race of the Bouides. Being appointed first physician to that prince, he found means to gain his confidence to so great a degree, that he raised him to the post of Grand Visir. But he did not long enjoy that illustrious dignity. Too great an attachment for pleasures, especially those of love and the table, made him lose at the same time his post and his master's favour. From that time Avicènes felt all the rigours of adversity, which he had brought upon himself by his ill conduct. He wandered about as a fugitive, and was often obliged to shift the place of his habitation to secure his life from danger. He died at Hamadan, aged 58 years, in the 428th year of the Hegira, and of Christ 1036.

The perfect knowledge he had of physic did not secure him from the ailments that afflict human nature. He was attacked by several maladies in the course of his life, and particularly was very subject to the colic. His excesses in pleasure, and his infirmities, made a poet say, who wrote his epitaph, that the profound study of philosophy had not taught him good morals, nor that of medicine the art of preserving his own health.

No

No one composed with greater facility than Avicènes, writing, when he sat down to it, 50 pages generally in a day, without fatiguing himself. The doctors of Chiras, having made a collection of objections against one of his metaphysical works, sent it to him at Ispahan by Casem. This learned man, not arriving till towards evening, came to Avicènes's house, with whom he sat discoursing till midnight. When Casem was retired, he wrote an answer to the objections of the Chirazians, and finished it before sun-rise. He immediately delivered it to Casem, telling him, that he had made all possible dispatch in order not to detain him any longer at Ispahan.

Avicènes, after his death, enjoyed so great a reputation, that till the 12th century he was preferred for the study of philosophy and medicine to all his predecessors. His works were the only writings in vogue in schools, even in Europe. The following are the titles. 1. Of the Utility and Advantage of Sciences, XX books. 2. Of Innocence and Criminality, II books. 3. Of Health and Remedies, XVIII books. 4. On the Means of preserving Health, III books. 5. Canons of Physic, XIV books. 6. On Astronomical Observations, I book. 7. On Mathematical Sciences. 8. Of Theorems, or Mathematical and Theological Demonstrations, I book. 9. On the Arabic Language, and its Proprieties, X books. 10. On the Last Judgment. 11. On the Origin of the Soul, and the Resurrection of Bodies. 12. Of the End we should propose to ourselves in Harangues and Philosophical Argumentation. 13. Demonstration of the collateral Lines in the Sphere. 14. Abridgment of Euclid. 15. On Finity and Infinity. 16. On Physics and Metaphysics. 17. On Animals and Vegetables, &c. 18. Encyclopedie, 20 volumes.—Some, however, charge him with having stolen what he published, from a celebrated physician who had been his master. This man had acquired so much honour and wealth, that he was solicited by many to take their sons to be his scholars, or even his servants; but being resolved not to discover the secrets of his art, he would receive none of them. Avicènes's mother formed the following stratagem: she offered him her son as a servant, pretending he was naturally deaf and dumb; and the youth, by his mother's instructions, counterfeited these defects so well, that the physician, after making several trials to discover the reality of them, took the boy into his service, and by degrees trusted him so far as to leave his writings open in his room when he went abroad: Avicènes took that opportunity to transcribe them, and carried the copies to his mother; and after the death of his master he published them under his own name. Indeed if we reflect that he lived but 58 years, that he was a wanderer and a fugitive, and that he was much addicted to his pleasures, we shall have some difficulty to conceive how he could find time to compose so many works. Physic, however, is indebted to him for the discovery of cassia, rhubarb, mirabolans, tamarinds; and from him also, it is said, came to us the art of making sugar.

AVICENIA, Eastern Anacardium: A genus of the angiospermia order, belonging to the didynamia class of plants; and in the natural method ranking under the 40th order, *Personatæ*. The calyx is quinquepartite; the corolla is bilabiated, the upper lip squared; the capsule is leathery, romb-like, and monospermous. There are two species; the tomentosa or downy, and the nitida or shining. The seeds of the first are said to be the Malacca beans formerly kept in the shops (though this is doubtful), the kernels of which were eaten as almonds. The plant producing the Malacca bean, as it is called, is rather thought to be the Bontia *Germinans*.

AVIGATO pear. See Laurus.

AVIGLIANO, a small town of Piedmont in Italy. E. Long. 7. 5. N. Lat. 44. 40.

AVIGNON, a city of Provence in France, the capital of the county of Venaissin, and seated on the banks of the Rhone. It is an archbishop's see, and the residence of several popes at this place for 70 years has rendered it considerable. It still belongs and is subject to the pope, who sends a vice-legate every three years, who in some sense is the governor: and Mr Swinburn is of opinion the ecclesiastical government here is more for the benefit of the people than if they were subject to the king of France. Near the Rhone there is a large rock, within the circumference of the walls, upon which is a platform, from whence may be had a prospect of the whole city and the places about it. This city is about three miles and two furlongs in circumference, and is in general ill built, irregular, and devoid of beauty. But it is surrounded by handsome battlemented walls and turrets, not unlike those of Rome; and its public edifices are large, solid, and grand as the taste of the fourteenth century could make them. Several popes and anti-popes, who during their lives shook the Romish church with violence and mutual altercation, repose quietly near each other in the various monasteries of the place. The church of the Cordeliers contains, in an obscure corner, the almost defaced tomb of Petrarch's Laura and her husband Hugh de Sade; and nearly opposite is the tomb of the brave Gullon, so well known for his invincible courage as well as for his inviolable attachment to his sovereign Henry IV. Many productions of Reré of Anjou are to be seen in the city; whose inhabitants amount to above 30,000, of which 1000 are ecclesiastics and some hundreds of Jews. The palace of the vice-legate is composed of several large square towers, and he gives audience in a great hall which is full of fine paintings, as is also the chapel and the apartments. The arsenal is near the palace.

The church of Notre Dame is ancient, but not large, and is one of the best adorned in the city. After having ascended about 50 steps, you come to a very ancient portico, which sustains a great tower; as you enter the church on the left hand, you see paintings which equal the finest in Italy. The great altar is very magnificent, and is adorned with a shrine that contains the relics of we know not how many saints. The treasure of the sacristy is worthy of the curiosity of the traveller. The little palace where the archbishop resides is formed of three bodies of lodgings, accompanied with courts and small pavilions. It overlooks the Rhone, the city, and the fields. These buildings and the mint adorn a large square, which is the common walk of the inhabitants.

In Avignon they reckon seven gates, seven palaces, seven colleges, seven hospitals, seven monasteries, seven nunneries, and seven popes who have lived there in in 70 years. The steeples are numerous, and the bells are never at rest; one of silver is rung only on the death of a pope. The church of the Celestines is very magnificent, and full of fine monuments, and the rest are not without their curiosities. The university has four colleges; and the place where the Jews, live is a distinct quarter, from whence the Jews, who pay tribute, dare not stir out without yellow hats, and the women must have something yellow about their heads, to distinguish them from the Christians. Their number is very considerable in a very confined place, where the only way of enlarging their abodes is by building their houses higher. Their synagogue is so dark, that they are obliged to light lamps. However, they are forced to hear a monk preach a sermon every week. Across the Rhone, here, extend the ruinous and decayed arches of that bridge against which Madame de Grignan was so near being lost, and of which Madame de Sevignè makes terrified mention. It was demolished in 1699 by one of the inundations common to the Rhone. When entire, it was not less than a quarter of a mile in length; but being so narrow as not to permit two carriages to pass in any part, it had previously become almost useless; and motives of policy prevent the construction of a new bridge, while Avignon belongs to the papal see. The curious that travel this way go to see the fountain of Vaucluse, where the river Sorgues, which passes through this city, has its source; and whither Petrarch so often retired to indulge his grief and hopeless love. It is situated in a valley five miles distant from the city. The sides of the river are skirted by meadows of the most lively green; above which rise abrupt and lofty rocks, that seem designed to seclude it from human view. The valley becomes gradually narrower toward the extremity, and winding continually describes the figure of a horse-shoe. The view is at length terminated by an enormous mass of rock, forming a barrier across it, of a prodigious height, and absolutely perpendicular. Through its vast recesses run the streams which supply the fountain of Vaucluse, and at its foot appears a bason of water, several hundred feet in circumference, stretched like an expanse, silent and quiet. The sides are very steep, and it is said that in the middle no bottom can be discovered, though attempts have been often made for that purpose; a circumstance probably resulting from the violence with which the springs bubble up, which prevents any weight from descending beyond a certain depth. Though the fountain is clearer in itself than crystal, yet the incumbent rock casts a continual shade, approaching to black, over its surface. The water escaping from this state of inaction by a narrow passage, is immediately precipitated in a cascade down a rocky channel, where it foams over a number of vast detached stones, which intercept and impede its progress. They are covered with a deep green moss of many ages, and have probably tumbled from the mountains that overhang the torrent. The rocks themselves, which surround and invest this romantic spot, are worn by time and the inclemency of the weather into a thousand extraordinary and fantastic forms, to which imagination gives shape and figure. On one of the pointed extremities, and in a situation which appears almost inaccessible, are seen the remains of an ancient castle, projecting over the water. The peasants call it *Il castelle di Petrarca*, and add, with great simplicity, that Laura lived upon the opposite side of the river, under the bed of which was a subterranean passage by which the two lovers visited each other. Nothing is however more certain than that these are the ruins of the chateau belonging to the Lords or Seigneurs of Avignon; and the bishop of Cavaillon resided in it during the frequent visits which he used to make to Petrarch.—The poet's dwelling was much lower down, and nearer to the bank of the Sorgues, as evidently appears from his minute description of it, and the relation he gives of his quarrel with the Naiads of the stream, who encroached during the winter on his little adjoining territory. No remains of it are now to be discerned. Below the bridge there is an island where the Sorgues joins the Rhone, in which are several houses of pleasure. E. Long. 4. 59. N. Lat. 43. 57.

Avignon-Berry, the fruit of a species of lycium; growing plentifully near Avignon and in other parts of France. The berry is somewhat less than a pea; its colour is green, approaching towards a yellow; and is of an astringent and bitter taste.—It is much used by the dyers, who stain a yellow colour with it, and by the painters, who also make a fine golden yellow of it.

AVILA, a city of Old Castile, in Spain, seated on an eminence on the banks of the river Adaja, and in sight of the mountains of Pico. It is fortified both by nature and art, having a wall 9075 feet in circumference, adorned with 26 lofty towers, and 10 handsome gates. There are 17 principal streets, the houses in which are generally good, and some of them stately. It hath nine squares, 2000 houses, nine parishes, as many monasteries, seven nunneries, two colleges, nine hospitals, 18 chapels, and an allowance of 10,000 ducats yearly for the maintenance of orphans and other poor people. It has an university, and a considerable bishopric; besides a noble cathedral, which has eight dignitaries, 20 canons, and the same number of minor canons. It stands in the middle of a fine large plain, surrounded with mountains, and covered with fruit-trees and vineyards. There is likewise a manufacture of cloth. W. Long. 4. 13. N. Lat. 40. 35.

AVIS, a small town of Alentejo in Portugal, seated on an eminence, with a castle, near the river Avis. Hence the military order of the knights of Avis have their name. W. Long. 7. 0. N. Lat. 38 40.

Avis *(Knights d'Avis)*, an order of knighthood in Portugal established about the year 1162. When the city of Evora was taken from the Moors, in the reign of the first king of Portugal, it was garrisoned by several persons who assumed the title of knights of St Mary of Evora, which was soon after changed for that of knights d'Avis, which the king gave them, and whither they removed from Evora. The badge of the order is a green cross flory, and they observe the rule of St Benedict.

AVISO, a term chiefly used in matters of commerce to denote an advertisement, an advice, or piece of intelligence.

AVISON (Charles), organist of Newcastle, and a disciple of Geminiani, was the author of an essay on musical expression, published in the year 1752, in which are some judicious reflections on music in general, but his division of the modern authors into classes is rather fanciful than just. Throughout his book he celebrates Marcello and Geminiani; the latter frequently in prejudice to Mr. Handel. In the year 1753 came out remarks on Mr. Avison's essay on musical expression, the author whereof first points out sundry errors against the rules of composition in the works of Avison. In the same year Avison republished his essay, with a reply to the author of the remarks; and a letter, containing a number of loose particulars relating to music collected in a course of various reading, unquestionably written by Dr Jortin. Avison promoted and assisted in the publication of Marcello's music to the psalms adapted to English words. Of his own composition there are extant five collections of concertos for violins, 44 in number; and two sets of sonatas for the harpsichord and two violins, a species of composition little known in England till his time. The music of Avison is light and elegant, but it wants originality; a necessary consequence of his too close attachment to the style of Geminiani, which in a few particulars only he was able to imitate.

AUK, in ornithology. See ALCA.

BISHOP'S AUKLAND, a town in the bishopric of Durham in England, situated on the river Were. It is a sanctuary for debtors; and here the bishop has a princely palace and a noble park. W. Long. 0. 57. N. Lat. 54. 44.

AULA, is used for a court baron, by Spelman; by some old ecclesiastical writers, for the nave of a church, and sometimes for a court-yard.

AULA Regia or *Regis*, a court established by William the Conqueror in his own hall, composed of the king's great officers of state, who resided in his palace, and were usually attendant on his person. This court was regulated by the article which forms the eleventh chapter of Magna Charta, and established in Westminster-hall, where it hath ever since continued. See *King's Bench*.

AULCESTER, a town of Warwickshire in England. W. Long. 1. 47. N. Lat. 52. 15.

AULETES, in antiquity, denotes a flute-player. One of the Ptolemies, kings of Egypt, father of Cleopatra, bore the surname or denomination of *Auletes*.

AULIC, an epithet given to certain officers of the empire, who compose a court which decides, without appeal, in all processes entered in it. Thus we say, *aulic council*, *aulic chamber*, *aulic counsellor*.

The aulic council is composed of a president, who is a catholic; of a vice-chancellor, presented by the archbishop of Mentz; and of 18 counsellors, nine of whom are protestants and nine catholics. They are divided into a bench of lawyers, and always follow the emperor's court; for which reason they are called *justitium imperatoris*, the emperor's justice, and aulic council. The aulic court ceases at the death of the emperor; whereas the imperial chamber of Spire is perpetual, representing not only the deceased emperor, but the whole Germanic body, which is reputed never to die.

AULIC, in the Sorbonne and foreign universities, is an act which a young divine maintains upon being admitted a doctor in divinity. It begins by an harangue of the chancellor, addressed to the young doctor, after which he receives the cap, and presides at the aulic, or disputation.

AULIS (anc. geog.), a town of Bœotia, over against Chalcis of Eubœa, on the Euripus, where that strait is narrowest; and which were sometimes joined together by a mole or causeway, (Diodorus Siculus): a craggy situation, (Homer, Nonnus); and a village of the Tanagraei, (Strabo), distant from Chalcis three miles: A harbour famous for the rendezvous of a thousand ships under Agamemnon, previous to the Trojan expedition, (Livy, Virgil, Pliny). Now entirely destroyed.

AULNEGER. See ALNAGER.

AULON, anciently a town and dock or station for ships in Illyricum, on the Adriatic; now *Valona*, or *Volana*, a port-town in the duchy of Ferara on one of the mouths of the Po, on the gulf of Venice. E. Long. 13. Lat. 44. 50.

AULON, or *Aulona*, anciently a town of Elis, in Peloponnesus, on the confines of Messenia. Here stood a temple of Æsculapius; hence the epithet *Aulonius* given that divinity, (Pausanias).

AULOS, a Grecian long measure, the same with stadium.

AULPS, a town of Provence in France, in the diocese of Trejus, with the title of a Vigueria. E. Long. 6. 25. N. Lat. 43. 40.

AULUS GELLIUS. See GELLIUS.

AUMBRY, a country-word denoting a cup-board.

AUME, a Dutch measure for Rhenish wine, containing 40 English gallons.

AUNCEL-WEIGHT, an ancient kind of balance now out of use, being prohibited by several statutes, on account of the many deceits practised by it. It consisted of scales hanging on hooks, fastened at each end of a beam, which a man lifted up on his hand. In many parts of England, auncel-weight signifies meat sold by the hand, without scales.

AUNE, a long measure used in France to measure cloths, stuffs, ribbons, &c. At Rouen, it is equal to one English ell; at Calais, to 1.52; at Lyons, to 1.061; and at Paris, to 0.95

AUNGERVYLE (Richard), commonly known by the name of *Richard de Bury*, was born in 1281 at St Edmund's Bury in Suffolk, and educated at the university of Oxford: After which he entered into the order of Benedictine monks, and became tutor to Edward prince of Wales, afterwards king Edward III. Upon the accession of his royal pupil to the throne he was first appointed cofferer, then treasurer of the wardrobe, archdeacon of Northampton, prebendary of Lincoln, Sarum, and Litchfield, keeper of the privy seal, dean of Wells, and last of all was promoted to the bishoprick of Durham. He likewise enjoyed the offices of lord high chancellor, and treasurer of England; and discharged two important embassies at the court of France. Learned himself, and a patron of the learned, he maintained a correspondence with some of the greatest geniuses of the age, particularly with the celebrated Italian poet Petrarch. He was also of a most humane and benevolent temper, and performed many signal acts of charity. Every week he made eight quarters of wheat into bread, and gave it to the poor. Whenever he travelled between Durham and Newcastle, he distributed eight pounds sterling in alms; between Durham and Stockton five pounds, between Durham and Aukland five marks, and between Durham and

Middleham five pounds. He founded a public library at Oxford, for the use of the students, which he furnished with the best collection of books then in England; and appointed five keepers, to whom he granted yearly salaries. At the dissolution of religious houses in the reign of Henry VIII. Durham college, where he fixed the library, being dissolved among the rest, some of the books were removed to the public library, some to Baliol college, and some came into the hands of Dr George Owen, a physician of Godstow, who bought that college of king Edward VI. Bishop Aungervyle died at his manor of Aukland, April 24, 1345, and was buried in the south part of the cross isle of the cathedral church of Durham, to which he had been a benefactor. He wrote, 1. *Philobiblos*, containing directions for the management of his library at Oxford, and a great deal in praise of learning, in bad Latin. 2. *Epistolæ familiarium;* some of which are written to the famous Petrarch. 3. *Orationes ad principes*; mentioned by Bale and Pitts.

AUNIS, the smallest province in France, bounded on the north by Poictou, on the west by the ocean, on the east and south by Saintogne, of which it was formerly a part It is watered by the rivers Seure and Sarente, the former of which has its source at Seure in Poictou. The coast of this small district has the advantage of several ports, the most remarkable of which are Rochefort, Rochelle, Brouge, St Martin de Re, Tremblade, Tonnai, and Charente. The soil of this country is dry, yet produces good corn and plenty of wine. The marshes feed a great number of cattle, and the salt marshes yield the best salt in Europe.

AVOCADO, or AVIGATO, *Pear*. See LAURUS.

AVOCATORIA, a mandate of the emperor of Germany, addressed to some prince, in order to stop his unlawful proceedings in any cause appealed to him.

AVOIDANCE, in the canon law, is when a benefice becomes void of an incumbent; which happens either in fact, as by the death of the person; or in law, as by cession, deprivation, resignation, &c. In the first of these cases, the patron must take notice of the avoidance at his peril; but in avoidance by law, the ordinary is obliged to give notice to the patron, in order to prevent a lapse.

AVOIRDUPOIS. This is the weight for the larger and coarser commodities, such as groceries, cheese, wool, lead, &c. Bakers, who live not in corporation towns, are to make their bread by avoirdupois weight, those in corporations by troy weight. Apothecaries buy by avoirdupois weight, but sell by troy. The proportion of a pound avoirdupois to a pound troy is as 17 to 14.

AVOSETTA, in ornithology. See RECURVIROSTRA.

AVOWEE, one who has a right to present to a benefice. He is thus called in contradistinction to those who only have the lands to which the advowson belongs for a term of years, or by virtue of intrusion or disseisin.

AVOWRY, in law, is where a person distrained sues out a replevin; for then the distrainer must vow, and justify his plea, which is called his *avowry*.

AURA, among physiologists, an airy exhalation or vapour. The word is Latin, derived from the Greek, *αυρα, gentle wind.*

AURACH, a town of Germany with a good castle, in the south part of Suabia, in the duchy of Wirtemberg. It is the usual residence of the youngest sons of the house of Wirtemberg, and is seated at the foot of a mountain on the rivulet Ermst. E. Long. 9. 20. N. Lat. 48. 25.

AURÆ, in mythology, a name given by the Romans to the nymphs of the air. They are mostly to be found in the ancient paintings of ceilings; where they are represented as light and airy, generally with long robes and flying veils of some lively colour or other, and fluttering about in the rare and pleasing element assigned to them. They are characterised as sportive and happy in themselves, and well-wishers to mankind.

AURANCHES, the capital of a territory called *Auranchin*, about 30 miles in length, in Lower Normandy in France. The city is mean; but its situation very fine, being on an eminence, near which the river See runs, about a mile and a half from the ocean. The cathedral stands on a hill, which terminates abruptly; the front of the church extending to the extreme verge of it, and overhanging the precipice. It bears the marks of high antiquity; but the towers are decayed in many places, though its original construction has been wonderfully strong. Here, you are told, the English Henry II. received absolution from the Papal nuncio for the murder of St Thomas-a-Becket in 1172; and the stone on which he knelt during the performance of that ceremony is shown to strangers. Its length is about 30 inches, and the breadth 12. It stands before the north portal, and on it is engraved a chalice in commemoration of the event.—The ruins of the castle of Auranches are very extensive, and beneath lies a rich extent of country, abounding in grain and covered with orchards, from the fruit of which is made the best cyder in Normandy. W. Long. 1. 20. N. Lat. 48. 51.

AURANTIUM, in botany. See CITRUS.

AURAY, a small seaport town of Lower Brittany in France, situated in the gulph called *Morbian.* It is nothing, properly speaking, but a large quay, and a handsome street, being chiefly known for its trade. W. Long. 2. 25. N. Lat. 47. 48.

AURELIA, in natural history, the same with what is more usually called *chrysalis*, and sometimes *nymph*. See CHRYSALIS.

AURELIANUS (Lucius Domitius), emperor of Rome, was one of the greatest generals of antiquity, and commanded the armies of the emperor Claudius with such glory, that after the death of that emperor all the legions agreed to place him on the throne: this happened in the year 270. He carried the war from the east to the west, with as much facility, says a modern writer, as a body of troops marches from Alsace into Flanders. He defeated the Goths, Sarmatians, Marcomanni, the Persians, Egyptians, and Vandals; conquered Zenobia queen of the Palmyrenians, and Tetricus general of the Gauls; both of whom were made to grace his triumph, in the year 274. He was killed by one of his generals in Thrace in the year 275, when he was preparing to enter Persia with a great army. See ROME.

AURELIUS VICTOR. See VICTOR.

AURENGABAD, a city in the East Indies, capital of the province of Balagate, in the dominions of the Great Mogul. It is furnished with handsome mosques and caravanseras. The buildings are chiefly of free-stone, and pretty high, and the streets planted on each side with trees. They have large gardens well stocked with fruit-trees and vines. The soil about it is also very fertile, and the sheep fed in its neighbourhood are remarkably large and strong. E. Long. 75. 30. N. Lat. 19. 10.

AURENG-ZEBE, the Great Mogul. See INDOSTAN.

AUREOLA, in its original signification, signifies a jewel, which is proposed as a reward of victory in some public dispute. Hence the Roman schoolmen applied it to denote the reward bestowed on martyrs, virgins, and doctors, on account of their works of supererogation; and painters use it to signify the crown of glory with which they adorn the heads of saints, confessors, &c.

AUREUS, a Roman gold coin, equal in value to 25 denarii.—According to Ainsworth, the aureus of the higher empire weighed near five pennyweights; and in the lower empire, little more than half that weight. We learn from Suetonius, that it was customary to give aurei to the victors in the chariot-races.

AUREUS MONS (anc. geog.), a mountain in the north-west of Corsica, whose ridge runs out to the north-east and south-east, forming an elbow—Another mountain of Moesia Superior, or Servia (Peutinger), to the south of the Danube, with a cognominal town at its foot on the same river. The emperor Probus planted this mountain with vines (Eutropius).

AURICK, a city of Germany; in East Friesland, in the circle of Westphalia; to which the king of Prussia claims a right. It is situated in a plain surrounded with forests full of game. E. Long. 6. 50. N. Lat. 53. 28.

AURICLE, in anatomy, that part of the ear which is prominent from the head, called by many authors *auris externa*.

AURICLES are likewise two muscular bags situated at the basis of the heart, and intended as diverticula for the blood during the diastole.

AURICULA, in botany. See PRIMULA.

AURIFLAMMA, in the French history, properly denotes a flag or standard belonging to the abbey of St Dennis, suspended over the tomb of that saint, which the religious, on occasion of any war in defence of their lands or rights, took down, with great ceremony, and gave it to their protector or advocate, to be borne at the head of their forces.

AURIFLAMMA is also sometimes used to denote the chief flag or standard in any army.

AURIGA, *the WAGGONER*, in astronomy, a constellation of the northern hemisphere, consisting of 23 stars, according to Tycho; 40, according to Hevelius; and 68, in the Britannic catalogue.

AURILLAC, a town of France in the Lower Auvergne, seated on a small river call *Jordane*. It is one of the most considerable towns of the province, has six gates, is very populous, and yet has but one parish. The castle is very high, and commands the town. The abbot is lord of Aurillac, and has episcopal jurisdiction; he is also chief justice of the town. This place is remarkable for having produced several great men. E. Long. 2. 33. N. Lat. 44. 55.

AURIPIGMENTUM, ORPIMENT, in natural history. See ORPIMENT.

AURISCALPIUM, an instrument to clean the ears, and serving also for other operations in disorders of that part.

AURORA, the morning twilight, or that faint light which appears in the morning when the sun is within 18 degrees of the horizon.

AURORA, the goddess of the morning, according to the Pagan mythology. She was the daughter of Hyperion and Theia, according to Hesiod; but of Titan and Terra, according to others. It was under this name that the ancients deified the light which foreruns the rising of the sun above our hemisphere. The poets represent her as rising out of the ocean, in a chariot, with rosy fingers dropping gentle dew. Virgil describes her ascending in a flame-coloured chariot with four horses.

AURORA, one of the New Hebrides islands in the South Sea, in which Mr Forster supposes the *Peak d'Etoile* mentioned by Mr Bouganville to be situated. The island is inhabited; but none of its inhabitants came off to visit Captain Cook. The country is woody, and the vegetation seemed to be excessively luxuriant. It is about 12 leagues long, but not above five miles broad in any part; lying nearly north and south. The middle lies in S. Lat. 15. 6. E. Long. 168. 24.

AURORA BOREALIS, NORTHERN TWILIGHT, or *Streamers;* a kind of meteor appearing in the northern part of the heavens, mostly in the winter-time, and in frosty weather. It is now so generally known, that no description is requisite of the appearance which it usually makes in this country. But it is in the arctic regions that it appears in perfection, particularly during the solstice. In the Schetland islands, the *merry dancers*, as they are there called, are the constant attendants of clear evenings, and prove great reliefs amidst the gloom of the long winter-nights. They commonly appear at twilight near the horizon, of a dun colour, approaching to yellow; sometimes continuing in that state for several hours without any sensible motion; after which they break out into streams of stronger light spreading into columns, and altering slowly into ten thousand different shapes, varying their colours from all the tints of yellow to the obscurest russet. They often cover the whole hemisphere, and then make the most brilliant appearance. Their motions at these times are most amazingly quick; and they astonish the spectator with the rapid change of their form. They break out in places where none were seen before, skimming briskly along the heavens; are suddenly extinguished, and leave behind an uniform dusky tract. This again is brilliantly illuminated in the same manner, and as suddenly left a dull blank. In certain nights they assume the appearance of vast columns, on one side of the deepest yellow, on the other declining away till it becomes undistinguished from the sky. They have generally a strong tremulous motion from end to end, which continues till the whole vanishes. In a word, we, who only see the extremities of these northern phenomena, have but a faint idea

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ideas of their splendor and their motions. According to the state of the atmosphere, they differ in colours. They often put on the colour of blood, and make a most dreadful appearance. The rustic sages become prophetic, and terrify the gazing spectators with the dread of war, pestilence, and famine. This superstition was not peculiar to the northern islands; nor are these appearances of recent date. The ancients called them *Chasmata*, and *Trabes*, and *Bolides*, according to their forms or colours.

In old times they were extremely rare, and on that account were the more taken notice of. From the days of Plutarch to those of our sage historian Sir Richard Baker, they were supposed to have been portentous of great events, and timid imaginations shaped them into aerial conflicts:

Fierce fiery warriors fight upon the clouds
In ranks and squadrons and right form of war.

1 This meteor formerly very rare.

Dr Halley tells us, that when he saw a great aurora borealis in 1716, he had begun to despair of ever seeing one at all; none having appeared, at least in any considerable degree, from the time he was born till then. Notwithstanding this long interval, however, it seems that in some periods the aurora borealis had been seen much more frequently; and perhaps this, as well as other natural phenomena, may have some stated times of returning.

2 History by Dr Halley.

The only thing that resembles a distinct history of this phenomenon, is what we have from the learned Dr Halley, Phil. Transf. n° 347. The first account he gives, is of the appearance of what is called by the author *burning spears*, and was seen at London on January 30th, 1560. This account is taken from a book intitled, *A description of Meteors*, by *W. F.* D. D. and reprinted at London in 1654. The next appearance, on the testimony of Stow, was on October 7th, 1564. In 1574 also, according to Camden, and Stow abovementioned, an aurora borealis was observed two nights successively, *viz.* on the 14th and 15th of November, with much the same appearance as desciribed by Dr Halley in 1715-16, and which we now so frequently observe. Again, the same was twice seen in Brabant, in the year 1575; *viz.* on the 13th of February and 28th of September. Its appearances at both these times were described by Cornelius Gemma, professor of medicine in the university of Lovain, who compares them to spears, fortified cities, and armies fighting in the air. After this, Michael Mæstlin, tutor to the great Kepler, assures us, that at Baknang in the county of Wurtemberg in Germany, these phenomena, which he styles *chasmata*, were seen by himself no less than seven times in 1580. In 1581, they again appeared in an extraordinary manner in April and September, and in a less degree at some other times of the same year. In 1621, September 2d, this phenomenon was observed all over France, and described by Gassendus, who gave it the name of *aurora borealis:* yet neither this, nor any similar appearances posterior to 1574, are described by English writers till the year 1707; which, as Dr Halley observes, shows the prodigious neglect of curious matters which at that time prevailed. From 1621 to 1707, indeed, there is no mention made of an aurora borealis being seen by any body: and considering the number of astronomers who during that period were in a manner continually poring on the heavens, we may very reasonably conclude that no such thing did make its appearance till after an interval of 86 years. In 1707, a small one was seen in November; and during that year and the next, the same appearances were repeated five times. The next, on record is that mentioned by Dr Halley in March 1715-16, the brilliancy of which attracted universal attention, and by the vulgar was considered as marking the introduction of a foreign race of princes. Since that time those meteors have been so common, that no accounts have been kept of them.

It was for a long time a matter of doubt whether this meteor made its appearance only in the northern hemisphere, or whether it was also to be observed near the south pole. This is now ascertained by Mr Forster; who in his late voyage round the world along with Captain Cook, assures us, that he observed them in the high southern latitudes, though with phenomena somewhat different from those which are seen here. On Feb. 17, 1773, as they were in Lat. 58° south, "A beautiful phenomenon (says he) was observed during the preceding night, which appeared again this and several following nights. It consisted of long columns of a clear white light, shooting up from the horizon to the eastward, almost to the zenith, and gradually spreading on the whole southern part of the sky. These columns were sometimes bent sideways at their upper extremities; and though in most respects similar to the northern lights *(aurora borealis)* of our hemisphere, yet differed from them in being always of a whitish colour, whereas ours assume various tints, especially those of a fiery and purple hue. The sky was generally clear when they appeared, and the air sharp and cold, the thermometer standing at the freezing-point."

3 Mr Forster's account of similar appearances in the southern hemisphere.

Dr Halley observed that the aurora borealis described by him arose to a prodigious height, it being seen from the west of Ireland to the confines of Russia and Poland on the east; nor did he know how much farther it might have been visible; so that it extended at least 30 degrees in longitude, and from lat. 50° north it was seen all over the northern part of Europe; and what was very surprising, in all those places where it was visible, the same appearances were exhibited which Dr Halley observed at London. He observes, with seeming regret, that he could by no means determine its height for want of observations made at different places; otherwise he might as easily have calculated the height of this aurora borealis, as he did of the fiery globe in 1719*. To other philosophers, however, he gives the following exhortation. "When therefore for the future any such thing shall happen, all those that are curious in astronomical matters are hereby *admonished* and *intreated* to set their clocks to the apparent time at London, for example, by allowing so many minutes as is the difference of meridians; and then to note, at the end of every half hour precisely, the exact situation of what at that time appears remarkable in the sky; and particularly the azimuths of those very tall pyramids so eminent above the rest, and therefore likely to be seen furthest: to the intent that, by comparing these observations taken at the same moment in distant places, the difference of their azimuths may serve to determine how far these pyramids are distant from us." This advice of Dr Halley seems to have been totally neglected by all the philosophical people in Britain. In other countries, however, they have

4 Rises very high.

* See *Atmosphere*.

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have been more industrious. Father Boscovich has determined the height of an aurora borealis, observed on the 16th of December 1737 by the Marquis of Poleni, to have been 825 miles high; the celebrated Mr Bergman, from a mean of 30 computations, makes the average height of the aurora borealis to be 70 Swedish, or upwards of 460 English miles. Euler supposes it to be several thousands of miles high; and Mairan also assigns them a very elevated region. In the 74th volume of the philosophical transactions, Dr Blagden, when speaking of the height of some fiery meteors, tells us, that the "aurora borealis appears to occupy as high, if not a higher region above the surface of the earth, as may be judged from the very distant countries to which it has been visible at the same time." The height of these meteors, however, none of which appear to have exceeded or even arrived at the height of a hundred miles, must appear trifling in comparison of the vast elevations abovementioned. But these enormous heights, varying so exceedingly, show that the calculators have not had proper data to proceed upon; and indeed the immense extent of space occupied by the aurora borealis itself, with its constant motion, must make it infinitely more difficult to determine the height of it than of a fiery globe, which occupies but a small portion of the visible heavens. The most certain method of making a comparison betwixt the aurora borealis and the meteors already mentioned, would be, if a ball of fire should happen to pass through the same part of the heavens where an aurora borealis was; when the comparative height of both could easily be ascertained. One instance of this only has come under our observation, where one of the small meteors, called *falling stars*, was evidently obscured by an aurora borealis; and therefore must have been higher than the lower part of the latter at least. A singularity in this meteor was, that it did not proceed in a straight line through the heavens, as is usual with falling stars, but described a very considerable arch of a circle, rising in the northwest, and proceeding southward a considerable way in the arch of a circle, and disappearing in the north. Its edges were ill defined, and five or six corruscations seemed to issue from it like the rays painted as issuing from stars. The aurora borealis was not in motion, but had degenerated into a crepusculum in the northern part of the hemisphere. Indeed in some cases this kind of crepusculum appears so plainly to be connected with the clouds, that we can scarcely avoid supposing it to proceed from them. We cannot, however, argue from this to the height of the aurora borealis when it moves with great velocity, because it then may, and very probably does, ascend much higher. Dr Blagden, indeed, informs us, that instances are recorded, where the northern lights have been seen to join, and form luminous balls, darting about with great velocity, and even leaving a train like the common fire-balls. It would seem therefore, that the highest regions of the aurora borealis are the same with those in which fireballs move.

5 Conjectures concerning the cause of this meteor.

With regard to the cause of the aurora borealis, many conjectures have been formed. The first which naturally occurred was, that it was occasioned by the ascent of inflammable sulphureous vapours from the earth. To this supposition Dr Halley objects the immense extent of such phenomena, and that they are constantly observed to proceed from north to south, but never from south to north. This made him very reasonably conclude, that there was some connection between the poles of the earth and the aurora borealis; but being unacquainted with the electric power, he supposed, that this earth was hollow, having within it a magnetical sphere, which corresponded in virtue with all the natural and artificial magnets on the surface; and the magnetic effluvia passing through the earth, from one pole of the central magnet to another, might sometimes become visible, in their course, which he thought was from north to south, and thus exhibit the beautiful corruscations of the aurora borealis. Had Dr Halley, however, known that a stroke of electricity would give polarity to a needle that had it not, or reverse the poles of one that had it before, he would undoubtedly have concluded the electric and magnetic effluvia to be the same, and that the aurora borealis was this fluid performing its circulation from one pole of the earth to the other. In fact, this very hypothesis is adapted by S. Beccaria; and by the supposed circulation of the electric fluid he accounts for the phenomena of magnetism and the aurora borealis in a manner perfectly similar to that of Dr Halley, only changing the phrase *magnetic effluvia* for *electric fluid*. The following is the account given us by Dr Priestley of Beccaria's sentiments on this matter.

"Since a sudden stroke of lightning gives polarity to magnets, he conjectures, that a regular and constant circulation of the whole mass of the fluid from north to south may be the original cause of magnetism in general.

"That this etherial current is insensible to us is no proof of its non-existence, since we ourselves are involved in it. He had seen birds fly so near a thunder-cloud, as he was sure they would not have done had they been affected by its atmosphere.

"This current he would not suppose to arise from one source, but from several, in the northern hemisphere of the earth; and he thinks that the aurora borealis may be in this electric matter performing its circulation in such a state of the atmosphere as renders it visible, or approaching the earth nearer than usual. Accordingly very vivid appearances of this kind have been observed to occasion a fluctuation in the magnetic needle.

A direct disproof of this circulation, however, is furnished by the observation of Mr Forster already mentioned; with which, though neither Dr Halley nor S. Beccaria could be acquainted, they might have thought of it as a final proof either of the truth or falsehood of their hypothesis.—If the aurora borealis is no other than the electric fluid performing the abovementioned circulation, it ought to dart from the horizon towards the zenith in the northern hemisphere, and from the zenith to the horizon in the southern one: but Mr Forster plainly tells us, that the columns shot up from the horizon towards the zenith as well in the southern hemisphere as in the northern; so that if the aurora borealis is to be reckoned the flashings of electric matter, its course is plainly directed from both poles towards the equator, and not from one pole to the other.

Concerning the cause of this phenomenon, Mr Canton has the following query: "Is not the aurora borealis

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realis the flashing of electrical fire from positive towards negative clouds at a great distance, through the upper part of the atmosphere where the resistance is least?" But to this we must reply in the negative; for in this case it would flash in evey direction according to the position of the clouds, as well as from north to south. Besides this query, he conjectures, that when the needle is disturbed by the aurora borealis, that phenomenon proceeds from the electricity of the heated air; and supposes the air to have the property of becoming electric by heat, like the tourmalin. But neither does this hypothesis appear at all probable; because, in such a case, the aurora borealis ought to be most frequent in summer when the air is most heated, whereas it is found to be the reverse.——Lastly, with these electrical hypotheses we shall contrast that of Mr Mairan, who imagined this phenomenon to proceed from the atmosphere of the sun, particles of which were thrown off by its centrifugal force acquired by his rotation on his axis; and that these particles falling upon the atmosphere of the earth near its equatorial parts, were from thence propelled by the diurnal motion of the earth towards the polar regions, where they formed the aurora borealis. This hypothesis, besides its being a mere supposition unsupported by one single appearance in nature, is liable to the objection already mentioned; for in this case the light should dart from the equator to the poles, and not from the poles to the equator: or if we should suppose this matter to be gradually accumulated at each of the poles, we must then make other suppositions equally vague and ill founded, concerning its getting back with such surprising rapidity in direct opposition to the power which once brought it thither.

The first person that seems to have endeavoured to find any positive proof for the electrical quality of the aurora borealis, is Dr Hamilton of Dublin. He observes, that though this phenomenon is commonly supposed to be electrical, yet he had not seen any attempt to prove that it is so: but the only proof he himself brings is an experiment of Mr Hawksbee, by which the electric fluid is shown to put on appearances somewhat like the aurora borealis, when it passes through a vacuum. He observed, that when the air was most perfectly exhausted, the streams of electric matter were then quite white; but when a small quantity of air was let in, the light assumed more of a purple colour. The flashing of this light therefore from the dense regions of the atmosphere into such as are more rare, and the transitions through mediums of different density, he reckons the cause of the aurora borealis, and of the different colours it assumes.

Dr Hamilton's proof, then, of the electricity of the aurora borealis, consists entirely in the resemblance the two lights bear to one another; and if to this we add, that, during the time of an aurora borealis, the magnetic needle hath been disturbed, electric fire obtained from the atmosphere in plenty, and at some times different kinds of rumbling and hissing sounds heard, we have the sum of all the positive evidence in favour of the electric hypothesis.

Was the aurora borealis the first natural phenomenon the solution of which had been attempted by electricity, no doubt the proofs just now adduced would be very insufficient: but when it is considered, that we have indisputable evidence of the identity of the phenomena of thunder and of electricity; when we also consider, that the higher parts of our atmosphere are continually in a strongly electrified state; the analogy becomes so strong, that we can scarce doubt of the aurora borealis arising from the same cause. The only difficulty is, to give a good reason why the electricity of the atmosphere should be constantly found to direct its course from the poles towards the equator, and not from the equator to the poles; and this we think may be done in the following manner.

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1. It is found that all electric bodies, when considerably heated, become conductors of electricity; thus hot air, hot glass, melted rosin, sealing wax, &c. are all conductors, till their heat is dissipated, and then they again become electrics.

See *Electricity passim.*

2. As the converse of every true proposition ought also to be true, it follows from the above one, that if electrics when heated become conductors, then non-electrics when subjected to violent degrees of cold ought to become electric. In one instance this has been verified by experience; water, which is a conductor when warm or not violently cooled, is found to become electric when cooled to 20° below 0 of Fahrenheit's thermometer. With regard to metallic substances, indeed, no experiments have as yet been made to determine whether their conducting power is affected by cold or not. Very probably we might not be able to produce such a degree of cold as sensibly to lessen their conducting power; but still the analogy will hold; and, as we are by no means able to produce the greatest degree of cold possible, reason will always suggest to us, that if a certain degree of cold changes one conductor into an electric, a sufficient degree of it will also change all others into electrics.

3. If cold is sufficient to change conducting substances into electrics, it must also increase the electric power of such substances as are already electric; that is to say, very cold air, glass, rosin, &c. provided they are dry, will be more electric than when they are warmer. With regard to air, which is most to our present purpose, this is rendered extremely probable, by considering that clear frosty weather is of all others the most favourable for electric experiments. They may be made indeed to equal advantage almost in any state of the atmosphere, provided sufficient pains is used, but in dry hard frosts they will succeed much more easily that at any other time.

These three axioms being allowed, the cause of the aurora borealis is easily deduced from them. The air, all round the globe, at a certain height above its surface, is found to be exceedingly cold, and, as far as experiments have yet determined, exceedingly electrical also. The inferior parts of the atmosphere between the tropics, are violently heated during the day-time by the reflection of the sun's rays from the earth. Such air will therefore be a kind of conductor, and much more readily part with its electricity to the clouds and vapours floating in it, than the colder air towards the north and south poles. Hence the prodigious appearances of electricity in these regions, showing itself in thunder and other tempests of the most terrible kind. Immense quantities of the electric fluid are thus communicated to the earth, and the inferior warm atmosphere having once exhausted itself, must ne-

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cessarily be recruited from the upper and colder region. This becomes very probable from what the French mathematicians observed when on the top of one of the Andes. They were often involved in clouds, which, sinking down into the warmer air, appeared there to be highly electrified, and discharged themselves in violent tempests of thunder and lightning; while, in the mean time, on the top of the mountain, they enjoyed a calm and serene sky. In the temperate and frigid zones, the inferior parts of the atmosphere never being so strongly heated, do not part with their electricity so easily as in the torrid zone, and consequently do not require such recruits from the upper regions; but notwithstanding the difference of heat observed in different parts of the earth near the surface, it is very probable that at considerable heights the degree of cold is nearly equal all round it. Were there a like equality in the heat of the under part, there could never be any considerable loss of equilibrium in the electricity of the atmosphere: but as the hot air of the torrid zone is perpetually bringing down vast quantities of electric matter from the cold air that lies directly above it; and as the inferior parts of the atmosphere lying towards the north and south poles do not conduct in any great degree; it thence follows, that the upper parts of the atmosphere lying over the torrid zone will continually require a supply from the northern and southern regions. This easily shows the necessity of an electric current in the upper parts of the atmosphere from each pole towards the equator: and thus we are also furnished with a reason why the aurora borealis appears more frequently in winter than in summer; namely, because at that time the electric power of the inferior atmosphere is greater on account of the cold than in summer; and consequently the abundant electricity of the upper regions must go almost wholly off to the equatorial parts, it being impossible for it to get down to the earth: hence also the aurora borealis appears very frequent and bright in the frigid zones, the degree of cold in the upper and under regions of the atmosphere being much more nearly equal in these parts than in any other. In some parts of Siberia particularly, this meteor appears constantly from October to Christmas, and its corruscations are said to be very terrifying. Travellers agree, that here the aurora borealis appears in greatest perfection; and it is to be remarked, that Siberia is the coldest country on earth. In confirmation of this, it may also be observed, that, from the experiments hitherto made with the electrical kite, the air appears considerably more electrical in winter than in summer, though the clouds are known to be often most violently electrified in the summer time; a proof, that the electricity naturally belonging to the air is in summer much more powerfully drawn off by the clouds than in the winter, owing to the excess of heat in summer, as already observed.

A considerable difficulty, however, still remains, from the upright position which the streams of the aurora borealis are generally observed to have; whereas, according to the hypothesis abovementioned, they ought rather to run directly from north to south. This difficulty occured to Dr Halley: but he answers it by supposing his magnetic effluvia to pass from one pole to another in arches of great circles, arising to a vast height above the earth, and consequently darting from the places whence they arose almost like the radii of a circle; in which case, being sent off in a direction nearly perpendicular to the surface of the earth, they must necessarily appear erect to those who see them from any part of the surface, as is demonstrated by mathematicians. It is also reasonable to think that they will take this direction rather than any other, on account of their meeting with less resistance in the very high regions of the air than in such as are lower.

But the greatest difficulty still remains: for we have supposed the equilibrium of the atmosphere to be broken in the day-time, and restored only the night; whereas, considering the immense velocity with which the electric fluid moves, the equilibrium ought to be restored in all parts almost instantaneously; yet the aurora borealis never appears except in the night, although its brightness is such as must sometimes make it visible to us did it really exist in the day-time.

In answer to this it must be observed, that though the passage of electricity through a good conductor is instantaneous, yet through a bad conductor it is observed to take some time in passing. As our atmosphere therefore, unless very violently heated, is but a bad conductor of electricity; though the equilibrium in it is broken, it can by no means be instantaneously restored. Add to this, that as it is the action of the sun which breaks the equilibrium, so the same action, extending over half the globe, prevents almost any attempt to restore it till night; when flashes arise from various parts of the atmosphere, gradually extending themselves with a variety of undulations towards the equator.

It now remains to explain only one particularity of the aurora borealis, namely, that its streams do not always move with rapidity, sometimes appearing quite stationary for a considerable time, and sometimes being carried in different directions with a slow motion. To this indeed we can give no other reply, than that weak electric lights have been sometimes observed to put on the same appearance at the surface of the earth; and much more may we suppose them capable of doing so at great heights above it, where the conductors are both fewer in number and much more imperfect. When M. de Romans was making experiments with an electric kite in Italy, a cylinder of blue light about four or five inches diameter was observed surrounding the string. This was in the day-time; but had it been night, he imagined it must have been four or five feet in diameter; and as the string was 780 feet long, it would probably have seemed pyramidal, pointing upwards like one of the streams of the aurora borealis. A still more remarkable appearance, Dr Priestly tells us, was observed by Mr Hartman. He had been making electrical experiments for four or five hours together in a very small room; and upon going out of it, and returning with a light in his hand, walking pretty quick, he perceived a small flame following him at about three feet distance. Being alarmed at this appearance, he stopped to examine it, upon which it vanished. This last instance is very remarkable, and singular in its kind: from both, however, we are sufficiently warranted to conclude, that small portions of our atmosphere may by various causes be so much electri-

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Aurora Borealis. fied as to ſhine, and likewiſe be moved from one place to another without parting with the electricity they have received, for a conſiderable time.

The corona, or circle, which is often formed near the zenith by the aurora borealis, is eaſily accounted for in the ſame manner. As this corona is commonly ſtationary for ſome time, we imagine it would be a very proper mark whereby to determine the diſtance of the meteor itſelf. If an aurora borealis, for inſtance, was obſerved by two perſons, one at London, and the other at Edinburgh; by noting the ſtars among which the corona was obſerved at each place, its true altitude from the ſurface of the earth could eaſily be determined by trigonometry.

Under the article ATMOSPHERE it was ſuggeſted, that no good proof had been as yet brought for the extreme rarity of the air uſually ſuppoſed to take place at no very great heights above the earth. The brightneſs of the meteor there mentioned at 70 miles perpendicular from the ſurface, as alſo its figure, ſeemed to prove the air conſiderably denſer at that diſtance from the earth. Though the height of the aurora borealis has never been determined, we can ſcarce imagine it to be greater than that of this meteor, or indeed ſo great: but although its ſtreams reſemble the paſſage of electric light through a vacuum, it cannot be from thence inferred, that the air is at all in a ſtate ſimilar to the vacuum of an air-pump in thoſe places where the aurora borealis is produced; ſeeing we have inſtances of ſimilar appearances being produced in very denſe air. The plate of an electrophorus is often ſo highly electrified, as to throw out flaſhes from different parts as ſoon as it is lifted up, and by proper management it may be always made to emit long and broad flaſhes which ſhall ſcarcely be felt by the finger, inſtead of ſmall, denſe, and pungent ſparks; ſo that, though long flaſhes may be produced in rarefied air, it by no means follows that the ſame may not alſo be produced in denſer air. As little can we infer any thing from the colours; for we obſerve the electric ſpark ſometimes white, ſometimes blue, and ſometimes purple, in the very ſame ſtate of the atmoſphere, and from the ſame ſubſtance.

The aurora borealis is ſaid to be attended with a peculiar hiſſing noiſe in ſome very cold climates; Gmelin ſpeaks of it in the moſt pointed terms, as frequent and very loud in the north-eaſtern parts of Siberia; and other travellers have related ſimilar facts. Gmelin's account is very remarkable. "Theſe northern lights (ſays he) begin with ſingle bright pillars, riſing in the N. and almoſt at the ſame time in the N. E. which gradually increaſing comprehend a large ſpace of the heavens, ruſh about from place to place with incredible velocity, and finally almoſt cover the whole ſky up to the zenith. The ſtreams are then ſeen meeting together in the zenith, and produce an appearance as if a vaſt tent was expended in the heavens, glittering with gold, rubies, and ſaphire. A more beautiful ſpectacle cannot be painted; but whoever ſhould ſee ſuch a northern light for the firſt time, could not behold it without terror. For however fine the illumination may be, it is attended, as I have learned from the relation of many perſons, with ſuch a hiſſing, cracking, and ruſhing noiſe throughout the air, as if the largeſt fireworks were playing off. To deſcribe what they then hear, they make uſe of the expreſſion, *Spolochi chodjat*, that is, the ranging hoſt is paſſing. The hunters who purſue the white and blue foxes in the confines of the Icy Sea, are often overtaken in their courſe by theſe northern lights. Their dogs are then ſo much frightened, that they will not move, but lie obſtinately on the ground till the noiſe has paſſed. Commonly clear and calm weather follows this kind of northern lights. I have heard this account, not from one perſon only, but confirmed by the uniform teſtimony of many, who have ſpent part of ſeveral years in theſe very northern regions, and inhabited different countries from the Yeneſei to the Lena; ſo that no doubt of its truth can remain. This ſeems indeed to be the real birth-place of the *aurora borealis*."

The hiſſing or ruſhing noiſe above deſcribed, Dr Blagden is inclined to attribute to ſmall ſtreams of electric matter running off to the earth from the maſſes or accumulations of electricity by which the northern lights are ſuppoſed to be produced. 6

Aurora borealis ſucceeded by ſouth-weſt winds. We ſhall conclude this article with an account of a paper preſented to the Royal Society by Mr Winn, in 1772, wherein he ſays that the appearance of an aurora borealis, is a certain ſign of an hard gale of wind from the ſouth to ſouth-weſt. This he never found to fail in 23 inſtances; and even thinks, that from the ſplendor of the meteor, ſome judgment may be formed concerning the enſuing tempeſt. If the aurora is very bright, the gale will come on within twenty-four hours, but will be of no long duration; if the light is faint and dull, the gale will be leſs violent, and longer in coming on, but will alſo laſt longer. His obſervations were made in the Engliſh channel, where ſuch winds are very dangerous; and by attending to the auroræ, he ſays he often got eaſily out of it, when others narrowly eſcaped being wrecked. This is an exceeding uſeful obſervation for ſailors: but it cannot be expected that the winds ſucceeding theſe meteors ſhould in all places blow from the ſouth-weſt; though no doubt a careful obſervation of what winds ſucceed the aurora borealis, and other meteors, in different parts of the world, might contribute in ſome meaſure to leſſen the dangers of navigation. 7

Conjecture concerning the reaſon. That the aurora borealis ought to be ſucceeded by winds, may be eaſily deduced from the hypotheſis laſt mentioned. If this phenomenon is occaſioned by the vaſt quantity of electric matter conveyed to the equatorial parts of the earth, it is certain that the earth cannot receive any great quantity of this matter at one place without emitting it at another. The electricity, therefore, which is conſtantly received at the equator, muſt be emitted nearer the poles, in order to perform its courſe, otherwiſe there could not be a conſtant ſupply of it for the common operations of nature. It is obſerved, that electrified bodies are always ſurrounded by a blaſt of air, which is ſent forth from them in all directions; hence, if the electric matter find a more ready paſſage through one part of the earth than another, a wind will be found to blow from that quarter. If therefore one of theſe places happens to be in the Atlantic ocean near the coaſt of France, or in the bay of Biſcay, the electric matter which has been received at the equator during an aurora borealis will be diſcharged there ſome time after, and conſequently a wind will blow from that quarter, which will be from the ſouth-weſt to thoſe ſhips which are in the Engliſh channel.

channel. It cannot be imagined, however, that all the matter can be difcharged from one place; and therefore according to the different fituations of thofe electrical vents, winds may blow in different directions; and thus the fame aurora borealis may produce a fouth-weft wind in the Englifh channel, and a north-weft one in Scotland.

AURUM. See GOLD, CHEMISTRY, and METALLURGY.

This metal was introduced into medicine by the Arabians, who efteemed it one of the greateft cordials and comforters of the nerves. From them Europe received it without any diminution of its character; in foreign pharmacopœias it is ftill retained, and even mixed with the ingredients from which fimple waters are to be diftilled. But no one, it is prefumed, at this time expects any fingular virtues from it, fince it certainly is not alterable in the human body. Mr Geoffroy, though unwilling to reject it from the cordial preparations, honeftly acknowledges that he has no other reafon for retaining it than complaifance to the Arabian fchools. The chemifts have endeavoured, by many elaborate proceffes, to extract what they call a fulphur or anima of gold: but no method is as yet known of feparating the component parts of this metal; all the tinctures of it, and aurum potabile, which have hitherto appeared, are real folutions of it in aqua regia, diluted with fpirit of wine or other liquors, and prove injurious to the body rather than beneficial. A place, however, is now given in fome of the foreign pharmacopœias to the aurum fulminans; and it has of late been recommended as a remedy in fome convulfive difeafes, particularly in the chorea fancti viti.

AURUM Fulminans. See CHEMISTRY-*Index*.

AURUM Mofaicum. See CHEMISTRY-*Index*.

AURUNCI (anc. geog.), a people of Latium, towards Campania; the fame with the Aufones, at leaft fo intermixed as not to be eafily diftinguifhable, though Pliny feparates them.

AUSA, a town of Terraconenfis, in the middle age called *Aufona*; now *Vich de Ofona*, a town of Catalonia in Spain. E. Long. 2. N. Lat. 41. 50.

AUSCH. See AUCH.

AUSI, an ancient and very favage people of Libya. Herodotus tells us that they were unacquainted with marriage, and had all their women in common. The children were brought up by their mothers till they were able to walk: after which they were introduced to an affembly of the men, who met every three months; and the man to whom any child firft fpoke, acknowledged himfelf its father. They celebrated annually a feaft in honour of Minerva, in which the girls divided into two companies, fought with fticks and ftones, and thofe who died of their wounds were concluded not to have been virgins.

AUSIMUM, or AUXIMUM, an ancient Roman colony in the Picenum; now *Ofimo* or *Ofmo*, in the March of Ancona in Italy. E. Long. 15. N. Lat. 43. 20.

AUSITÆ, or ÆSITÆ, a tribe of ancient Arabs, fuppofed by Bochart to have inhabited the land of Uz mentioned in fcripture.

AUSONA (anc. geog.), a town of the Aufones, a people who anciently occupied all the Lower Italy, from the Promontorium Circæum down to the ftraits of Sicily (Livy), but were afterwards reduced to a much narrower compafs; namely, between the Montes Circæi and Maffici: nor did they occupy the whole of this, but other people were intermixed. Concerning Aufona or its remains there is nothing particular recorded.

AUSONIA, the ancient name of Italy, from its moft ancient inhabitants the Aufones, (Virgil, Servius).

AUSONEUM MARE (anc. geog.), a part of the Ionian fea, extending fouthwards from the promontory Japygium to Sicily, which it wafhes on the eaft, as it does the Brutii and Magna Græcia on the fouth and eaft. It is feparated from the Tufcan fea by the ftrait of Meffina.

AUSONIUS (in Latin *Decius*, or rather *Decimus*, Magnus Aufonius), one of the beft poets of the fourth century, was the fon of an eminent phyfician, and born at Bordeaux. Great care was taken of his education, the whole family interefting themfelves in it, either becaufe his genius was very promifing, or that the fcheme of his nativity, which had been caft by his grandfather on the mother's fide, made them imagine that he would rife to great honour. He made an uncommon progrefs in claffical learning, and at the age of 30 was chofen to teach grammar at Bourdeax. He was promoted fome time after to be profeffor of rhetoric; in which office he acquired fo great a reputation, that he was fent for to court to be preceptor to Gratian the emperor Valentinian's fon. The rewards and honours conferred on him for the faithful difcharge of his office prove the truth of Juvenal's maxim, that when fortune pleafes fhe can raife a man from a rhetorician to the dignity of a conful. He was actually appointed conful by the emperor Gratian, in the year 379, after having filled other confiderable pofts; for befides the dignity of queftor, to which he had been nominated by Valentinian, he was made prefect of the Prætorium in Italy and Gaul after that prince's death. His fpeech returning thanks to Gratian on his promotion to the confulfhip is highly commended. The time of his death is uncertain; he was ftill living in 392, and lived to a great age. The emperor Theodofius had a great efteem for Aufonius, and preffed him to publifh his poems. There is a great inequality in his works; and in his manners and his ftyle there is a harfhnefs which was perhaps rather the defect of the times he lived in than of his genius. Had he lived in Auguftus's reign, his verfes, according to good judges, would have equalled the moft finifhed of that age. He is generally fuppofed to have been a Chriftian: fome ingenious authors indeed think otherwife, but, according to Mr Bayle, without juft reafon. The beft edition of his poems is that of Amfterdam in 1671.

AUSPEX, a name originally given to thofe who were afterwards denominated *augurs*. In which fenfe the word is fuppofed to be formed from *avis*, "bird," and *infpicere*, "to infpect;" *aufpices*, q. d. *avifpices*. Some will therefore have aufpices properly to denote thofe who foretold future events from the fight of birds.

AUSPICIUM, AUSPICY, the fame with augury.

AUSTER, one of the four cardinal winds, as Servius

vius calls them blowing from the south, (Pliny, Ovid, Manilius).

AUSTERE, rough, astringent. Thus an austere taste is such a one as constringes the mouth and tongue; as that of unripefruits, harsh wines, &c.

AUSTERITY, among moral writers, implies severity and rigour. Thus we say *Austerity of manners, austerities of the monastic life, &c.*

AUSTIN, (St). See *St* AUGUSTIN.

AUSTRAL, AUSTRALIS, the same with southern. The word is derived from *auster*, "south wind." Thus austral signs are the six last signs of the zodiac; so called because they are on the south side of the equinoctial.

AUSTRALIS PISCES, the SOUTHERN FISH, is a constellation of the southern hemisphere, not visible in our latitude; whose stars in Ptolemy's catalogue are 18, and in the Britannic catalogue 24.

AUSTRIA, one of the principle provinces of the empire of Germany towards the east; from which situation is takes its name *Oost-ryck*, in the German language signifying the *East Country*. It is bounded on the north by Moravia; on the east by Hungary; on the south by Stiria; and on the west by Bavaria. It is divided into *Upper* and *Lower*. Upper Austria is situated on the south, and Lower Austria on the north, side of the Danube. Vienna the capital is in the Upper Austria, which contains several other very considerable towns. The country is very fertile, has a great many mines, and produces vast quantities of sulphur.

In the ninth and tenth centuries, Austria was the frontier of the empire against the barbarians. In 928, the emperor Henry the Fowler, perceiving that it was of great importance to settle some person in Austria who might oppose these incursions, invested Leopold, surnamed the *Illustrious*, with that country. Otho I. erected Austria into a marquisate in favour of his brother-in-law Leopold, whose descendant Henry II. was created duke of Austria by the emperor Frederic Barbarossa. His posterity became extinct in 1240, the states of the country, in order to defend themselves from the incursions of the Bavarians and Hungarians, resolved to put themselves under the protection of Henry marquis of Misnia; but Othogar II. king of Bohemia, being likewise invited by a party in the duchy took possession of it, alledging not only the invitation of the states, but also the right of his wife, heiress of Frederic the last duke. The emperor Rodolphus I. pretending a right to this duchy, refused to give Othogar the investiture of it; and afterwards killing him in battle, procured the right of it to his own family. From this Rodolphus the present house of Austria is descended, which for several centuries past has rendered itself so famous and so powerful, having given 14 emperors to Germany, and six kings to Spain.

In 1477, Austria was erected into an archduchy by the emperor Frederic the Pacific, for his son Maximilian, with these privileges: That these shall be judged to have obtained the investiture of the states, if they do not receive it after having demanded it three times; that if they receive it from the emperor, or the imperial ambassadors, they are to be on horseback, clad in a royal mantle, having in their hand a staff of command, and upon their head a ducal crown of two points, and surrounded with a cross like that of the imperial crown. The arch-duke is born privy-counsellor to the emperor, and his states cannot be put to the ban of the empire. All attempts against his person are punished as crimes of lesemajesty, in the same manner as those against the king of the Romans, or Electors. No one dared to challenge him to single combat. It is in his choice to assist at the assemblies, or to be absent; and he has the privilege of being exempt from contributions and public taxes, excepting 12 soldiers which he is obliged to maintain against the Turk for one month. He has rank immediately after the electors; and exercises justice in his states without appeal, by virtue of a privilege granted by Charles V. His subjects cannot even be summoned out of his province upon account of lawsuits, to give witness, or to receive the investiture of fiefs. Any of the lands of the empire may be alienated in his favour, even those that are feudal; and he has a right to create counts, barons, gentlemen, *poets*, and notaries. In the succession to his states, the right of birth takes place; and, failing males, the females succeed according to the lineal right; and if no heir be found, they may dispose of their lands as they please.

Upper Austria, properly so called, has throughout the appearance of a happy country; here are no signs of the striking contrast betwixt poverty and riches which offends so much in Hungary. All the inhabitants, those of the capital only excepted, enjoy that happy mediocrity which is the consequence of a gentle and wise administration. The farmer has property; and the rights of the nobility, who enjoy a kind of lower judicial power, are well defined. The south and south-west parts of the country are bounded by a ridge of hills, the inhabitants of which enjoy a share of prosperity unknown to those of the interior parts of France. There are many villages and market-towns, the inhabitants of which have bought themselves off from vassalage, are now their own governors, and belong some of them to the estates of the country. The cloisters, the prelates of which belong to the estates of the country, are the richest in Germany, after the immediate prelacies and abbacies of the empire. One of the great convents of Benedictines is worth upwards of 4000 millions of French livres, half of which goes to the exchequer of the country.

Lower Austria yearly exports more than two millions worth of guilders of wine to Moravia, Bohemia, Upper Austria, Bavaria, Saltzburg, and part of Stiria and Carinthia. This wine is sour, but has a great deal of strength, and may be carried all over the world without danger; when it is ten or twenty years old it is very good. This country is very well peopled. Mr Schlosser, in his political journal, which contains an account of the population of Austria, estimates that of this country at 2,100,000 men. The revenue of this country is about 14,000,000 florins; of which the city of Vienna contributes about five, as one man in the capital earns as much as three in the country.

The southern parts of Austria are covered with hills, which rise gradually from the banks of the Danube to the borders of Stiria, and are covered with woods. They lose themselves in the mass of mountains which run to the south of Germany, and stretch through all Stiria, Carniola, Carinthia, and Tyrol, to the Swiss Alps; and are probably, after Savoy and Switzerland, the higheſt part of the earth. The inhabitants of this extenſive ridge of mountains are all very much alike; they are a ſtrong, large, and, the GOITRES excepted, a very handſome people.

The characteriſtic of the inhabitants of all this country is ſtriking bigotry, united with ſtriking ſenſuality. You need only ſee what is going forwards here to be convinced that the religion taught by the monks is as ruinous for the morals as it is repugnant to Chriſtianity. The Ciciſbeos accompany the married women from their bed to church, and lead them to the very confeſſional. The bigotry of the public in the interior parts of Auſtria, which from the mixture of gallantry with it, is ſtill to be found even amongſt people of rank, degenerates amongſt the common people into the groſſeſt and moſt abominable buffoonery. The Windes, who are mixed with the Germans in theſe countries, diſtinguiſh themſelves by a ſuperſtitious cuſtom that does little honour to the human underſtanding, and would be incredible if we had not the moſt unequivocal proofs of the fact before our eyes. Many years ago, they ſet out in company with ſome Hungarian enthuſiaſts to Cologne on the Rhine, which is about 120 German miles diſtant, to cut off the beard of a crucifix there. Every ſeven years this operation is repeated, as in this ſpace of time the beard grows again to its former length. The rich perſons of the aſſociation ſend the poorer ones as their deputies, and the magiſtrates of Cologne receive them as embaſſadors from a foreign prince. They are entertained at the expence of the ſtate, and a counſellor ſhews them the moſt remarkable things in the town. This farce brings in large ſums of money at ſtated times, and may therefore deſerve political encouragement; but ſtill, however, it is the moſt miſerable and meaneſt way of gain that can be imagined. Theſe Windes have alone the right to ſhave our Saviour, and the beard grows only for them. They firmly believe, that if they did not do this ſervice to the crucifix, the earth would be ſhut to them for the next ſeven years, and there would be no harveſts. For this reaſon they are obliged to carry the hair home with them, as the proof of having fulfilled their commiſſion, the returns of which are diſtributed amongſt the different communities, and preſerved as holy reliques. The Imperial court has for a long time endeavoured in vain to prevent this emigration, which deprives agriculture of ſo many uſeful hands. When the Windes could not go openly, they would go clandeſtinely. At length the court thought of the expedient of forbidding the regency of Cologne to let them enter the town. This happened ſix years ago, and the numerous embaſſy was obliged to beg its way back again without the wonderful beard; which without doubt the Capuchins, to whom the crucifix belonged, uſed to put together from their own. The trade which the monks carry on with holy ſalves, oils, &c. is ſtill very conſiderable; a prohibition of the court, lately publiſhed has rather leſſened it, but it cannot be entirely ſuppreſſed till next generation. It is now carried on ſecretly, but perhaps to nearly as great an amount as formerly.

AUSTROMANCY, AUSTROMANTIA, properly denotes foothſaying, or a vain method of predicting futurity, from obſervations of the winds.

AUTERFOITS ACQUIT. *AUTERFOITS Attaint.* *AUTERFOITS Convict.* } See the article *PLEA to Indictment.*

AUTHENTIC, ſomething of acknowledged and received authority. In law, it ſignifies ſomething clothed in all its formalities, and atteſted by perſons to whom credit has been regularly given. Thus we ſay, *authentic papers, authentic inſtruments.*

AUTHOR, properly ſignifies one who created or produced any thing. Thus God, by way of eminence, is called the *Author of nature,* the *Author of the univerſe.*

AUTHOR, in matters of literature, a perſon who has compoſed ſome book or writing.

AUTHORITY, in a general ſenſe, ſignifies a right to command, and make one's ſelf obeyed. In which ſenſe, we ſay, *the royal authority, the epiſcopal authority, the authority of a father,* &c. It denotes alſo the teſtimony of an author, ſome apophthegm or ſentence of an eminent perſon quoted in a diſcourſe by way of proof.

Authority is repreſented, in painting, like a grave matron ſitting in a chair of ſtate, richly clothed in a garment embroidered with gold, holding in her righthand a ſword, and in her left a ſceptre. By her ſide is a double trophy of books and arms.

AUTOCHTHONES, an appellation aſſumed by ſome nations, importing that they ſprung, or were produced, from the ſame ſoil which they ſtill inhabited. In this ſenſe, *Autochthones* amounts to the ſame with *Aborigines.* The Athenians valued themſelves on their being Autochthones, *ſelf-born,* or γηγενεις, *earth-born;* it being the prevailing opinion among the ancients, that, in the beginning, the earth, by ſome prolific power, produced men, as it ſtill does plants. The proper Autochthones were thoſe primitive men who had no other parent beſides the earth. But the name was alſo aſſumed by the deſcendants of theſe men, provided they never changed their ancient ſeat, nor ſuffered other nations to mix with them. In this ſenſe it was that the Greeks, and eſpecially the Athenians, pretended to be Autochthones; and, as a badge thereof, wore a gold graſshopper woven in their hair, an inſect ſuppoſed to have the ſame origin.

AUTOCRATER, a perſon veſted with an abſolute independent power, by which he is rendered unaccountable to any other for his actions. The power of the Athenian generals, or commanders, was uſually limited; ſo that at the expiration of their office, they were liable to render an account of their adminiſtration. But, on ſome extraordinary occaſions, they were exempted from this reſtraint, and ſent with a full and uncontroulable authority: in which caſe they were ſtyled Αυτοκρατορες. The ſame people alſo applied the name to ſome of their ambaſſadors, who were veſted with a full power of determining matters according to their own diſcretion. Theſe were denominated Πρεσβεις Αυτοκρατορες, and reſembled our plenipotentiaries.

AUTO DA FE, act of faith. See ACT *of Faith.*

AUTODIDACTUS, a perſon ſelf-taught, or who has had no maſter, or aſſiſtant of his ſtudies, beſides himſelf.

AUTOGRAPH, denotes a perſon's hand-writing, or the original manuſcript of any book, &c.

AUTOLITHOTOMUS, he who cuts himself for the stone. Of this we have a very extraordinary instance given by Reiselius, in the Ephemerides of the Academy *Naturæ Curiosorum*, dec. 1. an. 3. obs. 192.

AUTOMATE, called also *Hiera*, one of the Cyclades, an island to the north of Crete (Pliny), said to have emerged out of the sea, between the islands Thera and Therasia, in the fifth year of the emperor Claudius; in extent thirty stadia, (Orosius).

AUTOMATON (from αυτος, *ipse* and μαομαι *excitor*), a self-moving machine, or one so constructed, by means of weights, levers, pullies, &c. as to move for a considerable time, as though endued with animal life. According to this description, clocks, watches, and all machines of that kind, are automata.

Under the article ANDROIDES, we observed that the highest perfection to which automata could be carried was to imitate exactly the motions and actions of living creatures, especially of mankind, which are more difficultly imitated than those of other animals. Very surprising imitations, however, have been made of other creatures. So long ago as 400 years before Christ, Archytas of Tarentum is said to have made a wooden pigeon that could fly; nor will this appear at all incredible, when we consider the flute-player made by M. Vaucanson, and the chess-player by M. Kempell. Dr Hook is also said to have made the model of a flying chariot, capable of supporting itself in the air. But M. Vaucanson abovementioned hath distinguished himself still more eminently. That gentleman, encouraged by the favourable reception of his flute-player, made a duck, which was capable of eating, drinking, and imitating exactly the voice of a natural one. Nay, what is still more surprising, the food it swallowed was evacuated in a digested state; not that it was really in a state of natural excrement, but only considerably altered from what it was when swallowed; and this digestion was performed on the principles of solution, not of trituration. The wings, viscera, and bones, of this artificial duck, were also formed so as very strongly to resemble those of a living animal. Even in the actions of eating and drinking, this resemblance was preserved; the artificial duck swallowed with avidity and vastly quick motions of the head and throat; and likewise muddled the water with his bill, exactly like a natural one.

M. Le Droz of La Chaux de Fonds in the county of Neufchattel, hath also executed some very curious pieces of mechanism, which well deserve to be ranked with those already mentioned. One was a clock, which was presented to his Spanish majesty; and had, among other curiosities, a sheep, which imitated the bleating of a natural one; and a dog watching a basket of fruit: when any one attempted to purloin the fruit, the dog gnashed his teeth and barked; and if it was actually taken away, he never ceased barking till it was restored. Besides this, he made a variety of human figures, which exhibited motions truly surprising; but all inferior to Mr Kempell's chess-player, which may justly be looked upon as the greatest master-piece in mechanics that ever appeared. See ANDROIDES.

AUTONOMIA, a power of living or being governed by our own laws and magistrates. The liberty of the cities which lived under the faith and protection of the Romans, consisted in their autonomia, *i. e.* they were allowed to make their own laws, and elect their own magistrates; by whom justice was to be administered, and not by Roman presidents or judges, as was done in other places which were not indulged the autonomia.

AUTOPYROS, from αυτος, and πυρος, *wheat*; in the *Ancient diet*, an epithet given to a species of bread, wherein the whole substance of the wheat was retained, without retrenching any part of the bran. Galen describes it otherwise, viz. as bread where only the coarser bran was taken out.—And thus it was a medium between the finest bread, called *similagineus*, and the coarsest called *furfuraceus*. This was also called *autopyrites* and *syncomistus*.

AUTRE-EGLISE, a village of Brabant, in the Austrian Netherlands; to which the left wing of the French army extended, when the confederates obtained the victory at Ramillies, in 1706. E. Long. 4. 50. N. Lat. 50. 40.

AUTRICUM, the capital of the Carnutas, a people of Gallia Celtica; afterwards called *Carnotena*, *Carnotenus*, and *Civitas Carnotenum*: Now *Chartres*, in the Orleanois on the Eure. E. Long. 1. 32. N. Lat. 48. 47.

AUTUMN, the third season of the year, when the harvest and fruits are gathered in. Autumn is represented, in painting, by a man at perfect age, clothed like the vernal, and likewise girded with a starry girdle; holding in one hand a pair of scales equally poised, with a globe in each; in the other hand, a bunch of divers fruits and grapes. His age denotes the perfection of this season; and the balance, that sign of the zodiac which the sun enters when our autumn begins.

Autumn begins on the day when the sun's meridian distance from the zenith, being on the decrease, is a mean between the greatest and the least; which in these countries is supposed to happen when the sun enters Libra. Its end coincides with the beginning of winter. Several nations have computed the years by autumns: the English Saxons, by winters. Tacitus tells us, the ancient Germans were acquainted with all the other seasons of the year, but had no notion of Autumn. Lidyat observes of the beginning of the several seasons of the year, that

Dat Clemens hyemem, dat Petres ver cathedratus,
Æstuat Urbanus, autumnat *Bartholomæus.*

Autumn has always been reputed an unhealthy season. Tetullian calls it *tentator valetudinum*: and the satyrist speaks of it in the same light, *Autumnus Libitinæ quæstus acerbæ*.

AUTUMNAL POINT, is that part of the equinox from which the sun begins to descend towards the south pole.

AUTUMNAL Signs, in astronomy, are the signs Libra, Scorpio, Sagittarius, through which the sun passes during the autumn.

AUTUMNAL Equinox, that time when the sun enters the autumnal point.

AUTUN, an ancient city of France in the duchy of Burgundy, the capital of the Autonois, with a bishop's see. The length of this city is about three quarters of a mile, and its breadth nearly equal. The river Arroux washes its ancient walls, whose ruins are so firm, and the stones so closely united, that they seem almost to be cut out of the solid rock. In this city are the ruins

of

of three ancient temples, one of which was dedicated to Janus, and another to Diana. Here are likewise a theatre and a pyramid, which last is probably a tomb; it stands in a place called the *field of urns*, because several urns had been found there. Here are also two antique gates of great beauty. The city lies at the foot of three great mountains, in E. Long. 4. 15. N. Lat. 45. 50.

AUTURA, or AUDURA, a river of Gallia Celtica, only mentioned in the lives of the saints. Now the *Eure*, which falls into the Seine, on the left-hand or south side.

AUVERGNE, a province of France, about 100 miles in length and 75 in breadth. It is bounded on the north, by the Bourbonnois; on the east, by Torez and Velay; on the west, by Limosin, Quercy, and La Marche; and on the south, by Rovergne and the Cevennes. It is divided into upper and lower; the latter, otherwise called *Limagne*, is one of the finest countries in the world. The mountains of Higher Auvergne render it less fruitful; but they afford good pasture, which feeds great numbers of cattle, which are the riches of that country. Auvergne supplies Lyons and Paris with fat cattle, makes a large quantity of cheese, and has manufactures of several kinds. The capital of the whole province is Clermont.

AUVERNAS, a very deep-coloured heady wine, made of black raisins so called, which comes from Orleans. It is not fit to drink before it is above a year old; but if kept two or three years, it becomes excellent.

AUXERRE, an ancient town of France in the duchy of Burgundy, and capital of the Auxerrois, with a bishop's see. The episcopal palace is one of the finest in France, and the churches are also very beautiful. This town is advantageously situated for trade with Paris, on the river Yone. E. Long. 3. 35. N. Lat. 47. 54

AUXESIS, in mythology, a goddess worshipped by the inhabitants of Egina, and mentioned by Herodotus and Pausanias.

AUXESIS, in rhetoric, a figure whereby any thing is magnified too much.

AUXILIARY, whatever is aiding or helping to another.

AUXILIARY Verbs, in grammar, are such as help to form or conjugate others; that is, are prefixed to them, to form or denote the moods or tenses thereof: as, *to have* and *to be*, in the English; *etre* and *avoir*, in the French; *ho* and *sono* in the Italian, &c. In the English language, the auxiliary verb *am* supplies the want of passive verbs.

AUXO, in mythology, the name of one of two Graces worshipped by the Athenians. See HEGEMONE.

AUXONNE, a small fortified town of France, in the duchy of Burgundy; seated on the river Saone, over which there is a bridge of 23 arches, to facilitate the running off of the waters after the overflowing of the river. At the end of the bridge is a causway 2250 paces long. E. Long. 5. 22. N. Lat. 47. 11.

AUXY; the French give the name of *auxy wool* to that which is spun in the neighbourhood of Abbeville, by those workmen who are called *houpiers*. It is a very fine and beautiful wool, which is commonly used to make the finest stockings.

AWARD, in law, the judgment of an arbitrator, or of one who is not appointed by the law a judge, but chosen by the parties themselves for terminating their differences. See ARBITER and ARBITRATION.

AWL, among shoemakers, an instrument wherewith holes are bored through the leather, to facilitate the stitching or sewing the same. The blade of the awl is usually a little flat and bended, and the point ground to an acute angle.

AWLAN, a small imperial town of Germany, in the circle of Suabia, seated on the river Kochen. E. Long. 11. 15 N. Lat. 48. 52.

AWME, or AUME, a Dutch liquid measure containing eight steckans, or 20 verges or verteels, equal to the tierce in England, or to one-sixth of a ton of France.

AWN, in botany. See ARISTA.

AWNING, in the sea-language, is the hanging a sail, tarpawling, or the like, over any part of the ship, to keep off the sun, rain or wind.

AX, a carpenter's instrument, serving to hew wood. The ax differs from the joiner's hatchet, in that it is made larger and heavier, as serving to hew large stuff; and its edge tapering into the middle of its blade. It is furnished with a long handle or helve, as being to be used with both hands.

Battle-AX. See CELT.

AXAMENTA, in antiquity, a denomination given to the verses or songs of the *salii*, which they sung in honour of all men. The word is formed, according to some, from *axare*, q. d. *nominare*. Others will have the *carmina saliaria* to have been denominated *axamenta*, on account of their having been written in *axibus*, or on wooden tables.

The *axamenta* were not composed, as some have asserted, but only sung by the *salii*. The author of them was Numa Pompilius; and as the style might not be altered, they grew in time so obscure, that the *salii* themselves did not understand them. Varro says they were 700 years old. Quint. Inst. Or. lib. i. c. 11.

AXAMENTA, or *Assamenta*, in ancient music, hymns or songs performed wholly with human voices.

AXAYACATL, the name of a species of fly, common in Mexico, about the Lake; the eggs of which being deposited in immense quantities, upon the rushes and corn-flags, form large masses, which are taken up by fishermen and carried to market for sale. This caviare, called *ahuauhtli*, which has much the same taste with the caviare of fish, used to be eat by the Mexicans, and is now a common dish among the Spaniards. The Mexicans eat not only the eggs, but the flies themselves, made up together into a mass, and prepared with saltpetre.

AXATI, a town of ancient Bætica, in the Bœtis; now *Lora*, a small city of Andalusia, in Spain, seated on the Guadalquivir. W. Long. 5. 20. N. Lat. 37. 20.

AXBRIDGE, a town of Somersetshire in England, consisting of one long narrow street. W. Long. 2. 20 N. Lat. 51. 30.

AXEL, a small fortified town in Dutch Flanders. E. Long. 3. 40. N. Lat. 51. 17.

AXHOLM, an island in the north-west part of Lincolnshire in England. It is formed by the rivers Trent, Idel, and Dan; and is about ten miles long and five broad. The lower part is marshy, but produces an odoriferous

odoriferous shrub called *gall*; the middle is rich and fruitful, yielding flax in great abundance, as also alabaster which is used for making lime. The principal town is called *Axey*, and is now thinly inhabited.

AXIACE, an ancient town of Sarmatia Europea; now *Oxakow*, the capital of Budziac Tartary. E. Long. 32. 30. N. Lat. 46. 0.

AXILLA, in anatomy, the arm-pit, or the cavity under the upper part of the arm.

AXILLA, in botany, is the space comprehended between the stems of plants and their leaves. Hence we say those flowers grow in the axillæ of the leaves; *i. e.* at the base of the leaves, or just within the angle of their pedicles.

AXILLARY, something belonging to or lying near the axilla. Thus, *axillary artery* is that part of the subclavian branches of the ascending trunk of the aorta which passeth under the arm-pits; *axillary glands* are situated under the arm-pits, enveloped in fat, and lie close by the axillary vessels; and *axillary vein* is one of the subclavians which passes under the arm-pit, dividing itself into several branches, which are spread over the arm.

AXIM, a small territory on the gold-coast in Africa. The climate here is so excessively moist, that it is proverbially said to rain 11 months and 29 days of the year. This excessive moisture renders it very unhealthy; but it produces great quantities of rice, water melons, lemons, oranges, &c. Here are also produced vast numbers of black cattle, goats, sheep, tame pigeons, &c. The whole country is filled with beautiful and populous villages, and the intermediate lands well cultivated; besides which, the natives are very wealthy, from the constant traffic carried on with them by the Europeans for their gold. The capital which is also called *Axim*, by some *Achombone*, stands under the cannon of the Dutch fort St Antonio. Behind, it is secured by a thick wood that covers over the whole declivity of a neighbouring hill. Between the town and the sea runs an even and spacious shore of beautiful white sand. All the houses are separated by groves of cocoa and other fruit trees, planted in parallel lines, each of an equal width, and forming an elegant vista. The little river Axim crosses the town; and the coast is defended by a number of small pointed rocks, which project from the shore, and render all access to it dangerous. The capital is situated in W. Long. 24. 0. N. Lat. 5.0. This canton is a kind of republic, the government being divided between the Caboceroes or chief men, and Manaceroes or young men. It must be observed, however, that in their courts there is not even a pretence of justice: whoever makes the most valuable presents to the judges is sure to gain his cause, the judges themselves alledging the gratitude due for the bribes received as a reason: and if both parties happen to make presents of nearly equal value, they absolutely refuse to give the cause a hearing.

AXINOMANCY, AXINOMANTIA, from αξινη, *securis*, and μαντεια, *divinatio*; an ancient species of divination, or a method of foretelling future events by means of an ax or hatchet.—This art was in considerable repute among the ancients; and was performed, according to some, by laying an agate-stone on a red-hot hatchet; and also by fixing a hatchet on a round stake so as to be exactly poised; then the names of those that were suspected were repeated, and he at whose name the hatchet moved was pronounced guilty.

AXIOM, AXIOMA (from αξιοω, *I am worthy*); a self-evident truth, or a proposition whose truth every person receives at first sight. Thus, that the whole is greater than a part; that a thing cannot be and not be at the same time; and that from nothing, nothing can arise; are axioms.

AXIOM is also an established principle in some art or science. Thus, it is an axiom in physics, that nature does nothing in vain; that effects are proportional to their causes, &c. So it is an axiom in geometry, that things equal to the same thing are also equal to one another; that if to equal things you add equals, the sums will be equal, &c. It is an axiom in optics, that the angle of incidence is equal to the angle of reflection, &c.

AXIOPOLIS, a town of the Triballi in Mæsia Inferior; now *Axiopoli*, in Bulgaria. E. Long. 34. 0. N. Lat. 55. 40.

AXIS, in geometry, the straight line in a plain figure, about which it revolves, to produce or generate a solid. Thus, if a semicircle be moved round its diameter at rest, it will generate a sphere, the axis of which is that diameter.

AXIS, in astronomy, is an imaginary right line supposed to pass through the centre of the earth and the heavenly bodies, about which they perform their diurnal revolutions.

AXIS, in conic-sections, a right line dividing the section into two equal parts, and cutting all its ordinates at right angles.

AXIS, in mechanics. The axis of a balance is that line about which it moves, or rather turns about. *Axis of oscillation*, is a right line parallel to the horizon, passing through the centre about which a pendulum vibrates.

Axis in Peritrochio, one of the six mechanical powers, consisting of a peritrochium or wheel concentric with the base of a cylinder, and moveable together with it about its axis.

AXIS, in optics, is that particular ray of light coming from any object which falls perpendicularly on the eye.

AXIS, in architecture. *Spiral axis*, is the axis of a twisted column drawn spirally in order to trace the circumvolutions without. *Axis of the Ionic capital*, is a line passing perpendicularly through the middle of the eye of the volute.

Axis of a Vessel, is an imaginary right line passing through the middle of it perpendicularly to its base, and equally distant from its sides.

AXIS, in botany, is a taper column placed in the centre of some flowers or catkins, about which the other parts are disposed.

AXIS, in anatomy, the name of the second vertebra of the neck; it hath a tooth which goes into the first vertebra, and this tooth is by some called the *axis*.

AXMINSTER, a town of Devonshire, situated on the river Ax, in the great road between London and Exeter in W. Long. 3. 15. N. Lat. 50. 40. It was a place of some note in the time of the Saxons, but now contains only about 200 houses. Here is a small manufactory of broad and narrow cloths, and some carpets are also manufactured after the Turky manner.

AXOLOTLF. See LACERTA.

AXUMA, formerly a large city, and capital of the whole kingdom of Abyssinia in Africa, but now reduced to a miserable village scarce containing 100 inhabitants. E. Long. 36. 4. N. Lat. 14. 13.

AXUNGIA, in a general sense, denotes old lard, or the driest and hardest of any fat in the bodies of animals: but more properly it signifies only hog's lard.

AXUNGIA Vitri, Sandiver, or *Salt of Glass*, a kind of salt which separates from the glass while it is in fusion. It is of an acrimonious and biting taste. The farriers use it for cleansing the eyes of horses. It is also made use of for cleansing the teeth; and it is sometimes applied to running ulcers, the herpes, or the itch, by way of desiccative.

AXYRIS: A genus of the triandria order, belonging to the monœcia class of plants; and in the natural method ranking under the 12th order, *Holoraceæ*. The calyx of the male is tripartite; it has no corolla. The calyx of the female consists of two leaves; it has two styli and one seed. The species are four, none of them natives of Britain.

AY, a town of France in Champagne, near the river Mame, remarkable for its excellent wines. E. Long. 2. 15. N. Lat. 49. 4.

AYAMONTE, a sea-port town of Andalusia in Spain, with a strong castle built on a rock; seated on the mouth of the river Guadiana. It has a commodious harbour, fruitful vineyards, and excellent wine. W. Long. 8. 5. N. Lat. 37. 9.

AYENIA, in botany: A genus of the pentandria order, belonging to the gynandria class of plants; and in the natural method ranking under the 37th order, *Columniferæ*. The calyx has two leaves; the petals are in the form of a star, with long ungues; and the capsule has five cells. There are three species, all natives of the West-Indies.

AYLESBURY. See AILESBURY. This place gave title of Earl to the noble family of Bruce, now to a branch of the Brudenals by succession.

AYLMER (John), bishop of London, in the reign of Queen Elizabeth, was born in the year 1521, at Aylmer-hall in the parish of Tilney, in the county of Norfolk. Whilst a boy, he was distinguished for his quick parts by the Marquis of Dorset afterwards Duke of Suffolk; who sent him to Cambridge, made him his chaplain, and tutor to his children. One of these children was the unfortunate Lady Jane Gray, who soon became perfectly acquainted with the Latin and Greek languages. His first preferment was to the Archdeaconry of Stow in the diocese of Lincoln, which gave him a seat in the convocation held in the first year of Queen Mary, where he resolutely opposed the return to Popery, to which the generality of the clergy were inclined. He was soon after obliged to fly his country, and take shelter among the Protestants in Switzerland. On the accession of Queen Elizabeth, he returned to England. In 1562, he obtained the archdeaconry of Lincoln; and was a member of the famous synod of that year, which reformed and settled the doctrine and discipline of the church of England. In the year 1576, he was consecrated bishop of London. He died in the year 1594, aged 73; and was buried in St Paul's. He was a learned man, a zealous father of the church, and a bitter enemy to the Puritans. He published a piece intitled, *An harbrowe for faithful and trewe subjects against the late blowne blaste concerning the government of wemen*, &c. This was written whilst he was abroad in answer to Knox, who published a book at Geneva under this title, *The first blast against the monstrous regiment and empire of women*. He is by Strype supposed to have published Lady Jane Gray's letter to Harding. He also assisted Fox in translating his History of Martyrs into Latin.

AYRY, or AERY, *of Hawks*, a nest or company of hawks; so called from the old French word *aire*, which signified the same.

AYSCUE (Sir George), a gallant English admiral, descended from a good family in Lincolnshire. He obtained the honour of knighthood from King Charles I. which, however, did not with-hold him from adhering to the parliament in the civil war: he was by them constituted admiral of the Irish seas, where he is said to have done great service to the Protestant interest, and to have contributed much to the reduction of the whole island. In 1651 he reduced Barbadoes and Virginia, then held for the king, to the obedience of the parliament; and soon after the restoration behaved with great honour in the war with the Dutch. In the famous engagement in the beginning of June 1666, when Sir George was admiral of the white squadron, his ship the Royal Prince ran upon the Gallop-sand; where being surrounded with enemies, his men obliged him to strike. He went no more to sea after this, but spent the rest of his days in retirement.

AYMOUTH. See EYMOUTH.

AYTONIA, in botany: A genus of the monadelphia order, belonging to the pentandria class of plants; the characters of which are: The calyx is quinquepartite; the corolla consists of four petals; the berry is dry, quadrangular, unilocular, and many-seeded. There is but one species, the capensis, a native of the Cape, but of which we have found no particular description.

AZAB, in the Turkish armies, a distinct body of soldiery, who are great rivals of the Janissaries.

AZAI, a town of Touraine in France, seated on the river Indre. E. Long. 10. 35. N. Lat. 47. 18.

AZALEA, AMERICAN UPRIGHT HONEYSUCKLE: A genus of the monogynia order, belonging to the pentandria class of plants: and in the natural method ranking under the 18th order, *Bicornes*. The corolla is bell-shaped; the stamina are inserted into the receptacle; and the capsule has five cells. There are six species, of which the most remarkable are the following. 1. The viscosa, with a white flower, is a low shrub, arising with several stems to the height of two or three feet. The leaves come out in clusters without any order at the end of the shoots, and their edges are set with very short teeth which are rough. The flowers come out in clusters between the leaves, have much the appearance of honeysuckle, and are as well-scented. 2. The nudiflora, or red American upright honeysuckle, grows taller than the first; and in its native country will sometimes arrive at the height of 12 feet, but in Britain never rises to above half that height. It hath several stems with oblong smooth leaves. The flower-stalks arise from the division of the branches, which are long and naked,

naked, supporting a cluster of red flowers: these are divided at the top into five equal segments which spread open. Another species with bright red flowers was found by Mr Lightfoot upon the tops of many mountains in the Highlands of Scotland.—The first two species require a moist soil and a sandy situation, and can only be propagated from slips, as they never produce good seeds in Britain. The autumn is the best time to remove the plants, and their roots ought to be covered in winter. They are most beautiful plants, and well worth cultivating.

AZAMOR, a small sea-port town of the kingdom of Morocco in Africa. It is situated on the river Morbeya, in the province of Duguella, at some considerable distance from its mouth. This town, though formerly very considerable, is not proper for maritime commerce, because the entrance of the river is dangerous. It was unsuccessfully besieged by the Portuguese in 1508; it was taken, however, in 1513 by the Duke of Braganza, but abandoned about the end of the 16th century. W. Long. 7. 0. N. Lat. 32. 50.

AZARAKITES, a sect of Mahometan Arabs. See ARABIA, n° 143, *et seq.*

AZARIAH, or UZZIAH, king of Judah, succeeded his father Amaziah, 810 years before Christ. He assembled an army of above 300,000 men, with which he conquered the Philistines, and demolished the walls of Gath, Jabniel, and Ashdod; built up the walls of Jerusalem; furnished the city with conduits; and planted gardens and vineyards: but at last, being elated with his prosperity, and resolving to usurp the office of high priest, he was struck with a leprosy, which obliged him to remain shut up in his palace for the rest of his days. He died about 759 years before the Christian æra, and was succeeded by Jonathan his son.—There are several other persons of this name mentioned in the sacred Scriptures.

AZAZEL. The word relates to the scape-goat, under the Jewish religion. Some call the goat itself by this name, as St. Jerom and Theodoret. Dr Spencer says, the scape-goat was to be sent to Azazel; by which is meant the devil. M. le Clerc translates it *præcipitium*, making it to be that steep and inaccessible place to which the goat was sent, and where it was supposed to perish.

AZEKA, (anc. geog.) a city of the Amorrhites, in the lot of Judah; situated between Eleutheropolis and Aelia, (Jerome); where the five kings of the Amorrhites and their army were destroyed by hailstones from heaven, (Joshua).

AZEM, ASEM, ASSAM, or ACHEM, a country of Asia to the north of Ava, but which is very little known to Europeans. It is said to be very fertile, and to contain mines of gold, silver, iron, and lead, all which belong to the king, who, in consequence of enjoying the produce, requires no taxes from his people. They have also great quantities of gum lac, and coarse silk. It is also thought that the inhabitants of Azem were long ago the inventors of cannon and gun-power; and that from them the invention passed to the inhabitants of Pegu, and from thence to the Chinese.

AZIMUTH, in astronomy, an arch of the horizon, intercepted between the meridian of the place and the azimuth, or vertical circle passing through the centre of the object, which is equal to the angle of the zenith, formed by the meridian and vertical circle: or it is found by this proportion. As the radius to the tangent of the latitude of the place, so is the tangent of the sun's or star's altitude, for instance, to the cosine of the azimuth from the south, at the time of the equinox.

Magnetical AZIMUTH, an arch of the horizon intercepted between the azimuth, or vertical circle, passing through the centre of any heavenly body, and the magnetical meridian. This is found by observing the object with an azimuth-compass.

AZIMUTH-*Compass*, an instrument for finding either the magnetical azimuth or amplitude of an heavenly object.

The learned Dr Knight invented some time since a very accurate and useful sea-compass, which is at present used in the navy, and will be described under the article COMPASS. This instrument, with the following contrivance added by the ingenious Mr Smeaton, answers the purposes of an azimuth and amplitude compass.

The cover of the wooden box being taken off, the compass is in a condition to be made use of in the binnacle, when the weather is moderate; but if the sea runs high, as the inner box is hung very free upon its centre (the better to answer its other purposes), it will be necessary to slacken the milled nut, placed upon one of the axes that support the ring, and to lighten the nut on the outside that corresponds to it. By this means, the inner box and ring will be lifted up from the edges, upon which they rest, when free; and the friction will be increased, and that to any degree necessary, to prevent the too great vibrations, which otherwise would be occasioned by the motion of the ship.

To make the compass useful in taking the magnetic azimuth or amplitude of the sun and stars, as also the bearings of headlands, ships, and other objects at a distance, the brass edge designed at first to support the card, and throw the weight thereof as near the circumference as possible, is itself divided into degrees and halves; which may be easily estimated into smaller parts, if necessary. The divisions are determined by means of a catgut line, stretched perpendicularly with the box, as near the brass edge as may be, that the parallax, arising from a different position of the observer, may be as little as possible.

Underneath the card are two small weights, sliding on two wires, placed at right angles to each other; which being moved nearer to, or farther from, the centre, counterbalance the dipping of the card in different latitudes, or restore the equilibrium of it, where it happens by any other means to be got too much out of level.

There is also added an index at the top of the inner box, which may be put on and taken off at pleasure; and serves for all altitudes of the object. It consists of a bar equal in length to the diameter of the inner box, each end being furnished with a perpendicular stile, with a slit parallel to the sides thereof: one of the slits is narrow, to which the eye is applied; and the other is wider, with a small catgut stretched up the middle of it, and from thence continued horizontally from the top of one stile to the top of the other. There is also a a line drawn along the upper surface of the bar. These four, viz. the narrow slit, the horizontal catgut thread, the perpendicular one, and the line on the bar, are in the same plane, which disposes itself perpendicular to the horizon, when the inner box is at rest, and hangs free. This index does not move round, but is always placed on, so as to answer the same side of the box.

When the sun's azimuth is desired, and his rays are strong enough to cast a shadow, turn about the wooden box, till the shadow of the horizontal thread, or (if the sun be too low) till that of the perpendicular thread, in one stile, or the light through the slit on the other, falls upon the line in the index bar, or vibrates to an equal distance on each side of it, gently touching the box, if it vibrates too far: observe, at the same time, the degree marked upon the brass edge by the catgut line. In counting the degree for the azimuth, or any other angle that is reckoned from the meridian, make use of the outward circle of figures upon the brass edge; and the situation of the index bar, with regard to the card and needle, will always direct upon what quarter of the compass the object is placed.

But if the sun does not shine out sufficiently strong, place the eye behind the narrow slit in one of the stiles, and turn the wooden box about, till some part of the horizontal or perpendicular thread appears to intersect the centre of the sun, or vibrate to an equal distance on each side of it, using smoked glass next the eye, if the sun's light is too strong. In this method, another observer will be generally necessary, to note the degree cut by the nonius, at the same time that the first gives notice that the thread appears to split the object.

From what has been said, the other observations will be easily performed; only, in case of the sun's amplitude, take care to number the degree by the help of the inner circle of figures on the card, which are the complements of the outer to 90″; and, consequently, show the distance from east to west.

The azimuth of the stars may also be observed by night; a proper light serving equally for one observer to see the thread, and the other the degree upon the card.

It may not be amiss to remark farther, that, in case the inner box should lose its equilibrium, and, consequently, the index be out of the plane of a vertical circle, an accurate observation may still be made, provided the sun's shadow is distinct; for, by observing first with one end of the index towards the sun, and then the other, a mean of the two observations will be the truth.

Plate LXXVII. is a perspective view of the compass, when in order for observation; the point of view being the centre of the card, and the distance of the eye two feet. AB is the wooden box. C and D are two milled nuts; by means whereof the axis of the inner box and ring are taken from their edges, on which they move, and the friction increased, when necessary. E F is the ring that supports the inner box. GH is the inner box; and I is one of its axes, by which it is suspended on the ring E F. The magnet or needle appears passing through the centure, together with a small brace of ivory, that confines the cap to its place. The card is a single varnished paper, reaching as far as the outer circle of figures, which is a circle of thin brass; the edge whereof is turned down at right angles to the plane of the card, to make it more stiff. O is a catgut line, drawn down the inside of the box for determining the degree upon the brass edge. PQRS is the index bar, with its two stiles and catgut threads; which being taken off from the top of the box is placed in two peices, T and V, notched properly to receive it. W is a place cut out in the wood serving as an handle.

Azimuth Circles, called also *azimuths* or *vertical circles*, are great circles of the sphere intersecting each other in the zenith and nadir, and cutting the horizon at right angles. These azimuths are represented by the rhumbs on common sea-charts, and on the globe they are represented by the quadrant of altitude, when screwed in the zenith. On these azimuths is reckoned the height of the stars and the sun when not in the meridian.

AZMER, a town of the East Indies in the dominions of the Great Mogul, capital of a province of the same name, with a very strong castle. It is pretty large, and is sometimes visited by the Mogul himself. It is about 62 leagues distant from Agra. The principal trade of this province is in saltpetre.

AZOGA SHIPS, are those Spanish ships commonly called the *quicksilver ships*, from their carrying quicksilver to the Spanish West Indies, in order to extract the silver out of the mines of Mexico and Peru. These ships, strictly speaking, are not to carry any goods unless for the king of Spain's account.

AZONI, in ancient mythology, a name applied by the Greeks to such of the gods as were deities at large, not appropriated to the worship of any particular town or country; but acknowledged in general by all countries, and worshipped by every nation. These the Latins called *dii communes*. Of this sort were the Sun, Mars, Luna, &c.

AZORES, islands in the Atlantic ocean, lying between 25 and 33 degrees of west longitude, and between 36 and 40 degrees of north latitude. They belong to the Portuguese, and are also called the *western isles*, on account of their situation. They were discovered by the Flemings in the 15th century. They are seven in number, viz. Tercera, St Michael's, St Mary's, Graciosa, St George's Island, Pico, and Fayal.

AZOTH, in ancient chemistry, the first matter of metals, or the mercury of a metal; more particularly that which they call the *mercury of philosophers*, which they pretended to draw from all sorts of metallic bodies.

AZOTUS, AZOTH, or ASHDOD, one of the five cities of the Philistines, and a celebrated sea-port on the Mediterranean, situated about 14 or 15 miles south of Ekron, between that and Ascalon. It was in this city that the idol Dagon fell down before the ark; and so strong a place it was, if we may believe Herodotus, that it sustained a siege of 29 years by Psammiticus king of Egypt. It was, however, taken by the Maccabees in a much shorter time; who burnt both city and temple, and with them about 8000 men. The town is now called by the Arabs *Hasaneyun*. It is but thinly inhabited, though the situation

tion is very pleaſant: with regard to the houſes, thoſe that were built in the time of Chriſtianity, and which are now inhabited by Mahometans, ſtill preſerve ſome claim to admiration; but the modern buildings, tho' generally of ſtone, have nothing in them which can attract the notice of a traveller. The ſtreets are pretty broad, the inhabitants moſtly Mahometans, with a few Chriſtians of the Greek communion, who have a church under the juriſdiction of the archbiſhop of Gaza. The town is about a mile and a half in circumference; and has in it a moſque, a public bath, a market-place, and two inns. The number of the inhabitants is between two and three thouſand. The moſt remarkable things in this place are an old ſtructure with fine marble pillars, which the inhabitants ſay was the houſe that Sampſon pulled down; and to the ſouth-eaſt, juſt out of the town, the water in which the eunuch of Candace was baptized by the apoſtle Philip: beſides theſe two, there are ſeveral ancient buildings, with capitals and pillars ſtanding.

AZURE, in a general ſenſe, the blue colour of the ſky. See SKY and BLUE.

AZURE, among painters. This word, which at preſent ſignifies in general a fine blue colour, was formerly appropriated to *Lapis Lazuli*, called *azure ſtone*, and to the blue prepared from it. But ſince a blue has been extracted from cobalt, cuſtom has applied to it the name of *azure*, although it differs conſiderably from the former, and is incapable of being uſed for the ſame purpoſes, and particularly for painting in oil. The former at preſent is called *lapis lazuli;* or only *lapis;* and the blue prepared from it for painting in oil, is called *ultramarine*.—The name *azure* is generally applied to the blue glaſs made from the earth of cobalt and vitrifiable matters. This glaſs, which is called *ſmalt* when in maſſes, is called *azure* only when it is reduced to a fine powder. Several kinds of azure are diſtinguiſhed, according to its degrees of beauty, by the names of *fine azure, powdered azure,* and *azure of four fires*. In general, the more intenſe the colour, and the finer the powder, the more beautiful and dear it is. Azure is employed to colour ſtarch; hence it has alſo been called *ſtarch-blue*. It is uſed for painting with colours, and for a blue enamel.

AZURE, in heraldry, the blue colours in the arms of any perſon below the rank of a baron. In the eſcutcheon of a nobleman, it is called *ſapphire*; and in that of a ſovereign prince, *Jupiter*. In engraving this colour is expreſſed by lines or ſtrokes drawn horizontally. —This colour may ſignify Juſtice, Perſeverance, and Vigilance; but according to G. Leigh, if it is compounded with

Or	it ſignifies	Chearfulneſs.
Arg.		Vigilance.
Gul.		Readineſs.
Ver.		Enterprize.
Pur.		Goodneſs.
Sab.		Mournfulneſs.

French Heralds, *M. Upton*, and his followers, rank this colour before gules.

AZYGOS, in anatomy, a vein riſing within the thorax, on the right ſide, having no fellow on the left; whence it is called *azygos*, or *vena ſine pari.*

AZYMITES, in church-hiſtory, Chriſtians who adminiſter the euchariſt with unleavened bread. The word is formed from the Greek, α priv. and ζυμη *ferment*.—This appellation is given to the Latin by the Greek church, becauſe the members of the former uſe fermented bread in the celebration of the euchariſt. They alſo call the Armenians and Maronites by the ſame name, and for the ſame reaſon.

AZYMOUS, ſomething unfermented, or made without leaven; as unleavened bread. Sea-biſket is of this kind; and therefore, according to Galen, leſs wholeſome than bread that has been fermented.

B.

B, THE ſecond letter of the Engliſh and moſt other alphabets. It is the firſt conſonant, and firſt mute, and in its pronunciation is ſuppoſed to reſemble the bleating of a ſheep; upon which account Pierius tells us in his hieroglyphics, that the Egyptians repreſented the ſound of this letter by the figure of that animal.

B is alſo one of thoſe letters which the eaſtern grammarians call *labial*, becauſe the principal organs employed in its pronounciation are the lips. It is pronounced by preſſing the whole length of them together, and forcing them open with a ſtrong breath. It has a near affinity with the other labials P and V, and is often uſed for P both by the Armenians and other orientals, as in *Betrus* for *Petrus*, *apſens* for *abſens*, &c.; and by the Romans for V, as in *amabit* for *amavit*, *berna* for *verna*, &c. whence aroſe that jeſt of Aurelian on the emperor Bonoſus, *Non ut vivat natus eſt, ſed ut bibat*.

Plutarch obſerves, that the Macedonians changed Φ into B, and pronounced *Bilip*, *Berenice*, &c. for *Philip*, *Pherenice*, &c.; and thoſe of Delphos uſed B inſtead of Π, as βαθειν for παθειν, βικρον for πικρον, &c.—The Latins ſaid *ſuppono, oppono*, for *ſubpono, obpono*; and pronounced *optinuit*, though they wrote *obtinuit*, as Quintilian has obſerved.—They alſo uſed B for F or PH: thus, in an ancient inſcription mentioned by Gruter, OBRENDARIO is uſed for OFRENDARIO.

As a numeral, B was uſed by the Greeks and Hebrews to denote 2; but among the Romans for 300, and with a daſh over it (thus $\bar{B}$) for 3000.

B is also used as an abbreviation. Thus B. A. stands for bachelor of arts; B. L. for Bachelor of laws; and B. D. for bachelor of divinity. B. F. in the preface to the decrees or senatus-consulta of the old Romans signified *bonum factum*. In music, B stands for the tone above A; as B♭, or ♭B, does for B flat, or the semitone major above A. B also stands for bass; and B. C. for *basso continuo*, or thorough bass.

BAAL, the same as BEL, or BELUS; an idol of the Chaldeans and Phœnicians, or Canaanites. The former worshipped Mars under this name, according to Josephus*; who, speaking of Thurus the successor of Ninus says, "To this Mars the Assyrian erected the first statue, and worshipped him as a god, calling him *Baal*." It is probable the Phœnicians worshipped the sun under the name of Baal; for Josiah, willing to make some amends for the wickedness of Manasseh, in worshipping Baal and all the host of heaven, *put to death the idolatrous priests that burnt incense unto Baal, to the sun, and to the moon, and to the planets, and to all the host of heaven. He likewise took away the horses that the kings of Judah had given to the sun, and burnt the chariots of the sun with fire* †.

* Antiquit. lib. viii. cap. 7.

† 2 Kings xxiii. 5. 11.

The temples consecrated to this god, are called in the Scripture *Chamanim*, which signifies *places inclosed with walls*, in which was kept a perpetual fire. Maundrell, in his journey from Aleppo to Jerusalem, observed some traces of these inclosures in Syria. In most of them were no statues; in a few there were some, but of no uniform figure.

The word *baal* (in the Punic language), signifies *lord* or *master*; and doubtless meant the supreme Deity, the Lord and Master of the universe. It is often joined with the name of some false god, as *Baal-berith*, *Baal-peor*, *Baal-zephon*, and the like. This deity passed from the Phœnicians to the Carthaginians, who were a colony of the Phœnicians; as appears from the Carthaginian names, Hannibal, Asdrubal, &c. according to the custom of the east, where kings and great men added to their own names those of their gods.

This false deity is frequently mentioned in Scripture in the plural number (*Baalim*): which may signify, either that the name *Baal* was given to several different gods; or that there were many statues, bearing different appellations, consecrated to this idol. Arnobius tells us, that Baal was of an uncertain sex; and that his votaries, when they called upon him, invoked him thus: *Hear us, whether thou art a god or a goddess*.

Some learned men think, that the Baal of the Phœnicians is the Saturn of the Greeks; which is probable enough from the conformity there is between the human sacrifices offered to Saturn and those which the Scripture tells us were offered to Baal. Others are of opinion, that Baal was the Phœnician or Tyrian Hercules, a god of great antiquity in Phœnicia.

BAAL-BERITH, the god of the Shechemites. Bochart conjectures, that Berith is the same as *Beroe*, the daughter of Venus and Adonis, who was given in marriage to Bacchus; and that she gave her name to the city of Berith in Phœnicia, and became afterwards the goddess of it. Baal-berith signifies *Lord of the Covenant*, and may be taken for the god that presides over alliances and oaths, in like manner as the Greeks had their Ζευς ορκιος, and the Romans their *Deus Fidius*, or *Jupiter Pistius*. The idolatrous Israelites, we are told, *made Baal-berith their god*, Judg. viii. 33.

BAAL-PEOR, *Baal-phegor*, or *Beel-phegor*, an idol of the Moabites and Midianites. We are told, that *Israel joined himself to Baal-peor*; and that Solomon erected an altar to this idol upon the mount of Olives. Baal-peor has been supposed to be no other than a Priapus, and that the worship of him consisted in the most obscene practices. Others have thought, that, as Baal is a general name signifying *Lord*, Peor may be the name of some great prince deified after his death. Mede imagines, that, *Peor* being the name of a mountain in the country of Moab, on which the temple of Baal was built, Baal-peor may be only another name of that deity, taken from the situation of his temple; in like manner as Jupiter is styled *Olympius*, because he was worshipped in a temple built on mount Olympus. Selden, who is of this latter opinion, conjectures likewise, that Baal-peor is the same with Pluto; which he grounds upon these words of the Psalmist*; *They joined themselves unto Baal-peor, and eat the offerings of the dead*; though by the *sacrifices* or *offerings of the dead*, in this passage, may be meant no more than sacrifices or offerings made to idols, or false gods, who are very properly called *the dead*, in contradistinction to the true God, who is styled in Scripture the *living God*.

* Psalm cvi.

BAAL-ZEBUB, *Beel-zebub*, or *Belzebub*; the idol, or god, of the Ekronites. In Scripture he is called the *Prince of Devils*. His name is rendered the *Lord of Flies*, or the *God-fly*; which some think was a mock appellation bestowed on him by the Jews. He had a famous temple and oracle at Ekron. Ahaziah king of Israel, having fallen from the terrass of his house into a lower room, and being dangerously hurt, sent to consult this deity, to know if he should be cured of his wounds. The worship of this false god must have prevailed in our Saviour's time, since the Jews accused him of driving out devils in the name of *Belzebub* their prince. Scaliger derives the name of this deity from *Baalim-zebahim*, which signifies the *Lord of sacrifices*.

BABBLING, among hunters, is when the hounds are too busy after they had found a good scent.

BABEL, a city and tower undertaken to be built by the whole human race soon after the flood, and remarkable for the miraculous frustration of the attempt by the confusion of languages. As to the situation of ancient Babel, most authors are of opinion that it was, exactly in the place where the celebrated city of Babylon afterwards stood. That it was in the same country, appears indisputably from Scripture; but that it was exactly in the same place is what cannot be proved, nor is it a matter of any consequence.

Authors have been much divided about the motive by which the whole race of mankind were induced to join as one man in such an undertaking. Some have imagined that it was out of fear of a second deluge; others, that they knew beforehand that they were to be dispersed through all the different countries of the world, and built this tower in order to defeat the design of the Deity, because having a tower of such vast height as they proposed, those who were at a distance could easily find their way back again. Had either of these been their design, however, it is probable they would have chosen an eminence rather than a plain for

Babel.

the situation of their tower, or indeed that they would have chosen some high mountain such as Ararat for their mark, rather than any tower at all: for though it is said that they designed the top of their tower to reach to heaven, we can scarce suppose them to have been so absurd, as to imagine this possible in the sense we understand it; and must therefore rather take it in the limited sense in which it is often used by Moses and his countrymen, where they speak of cities walled up to heaven. Others there are who imagine that the top of this tower was not to reach up to heaven, but to be consecrated to the heavens, *i. e.* to the worship of the sun, moon, and stars; of the fire, air, &c. and other natural powers as deities; and therefore that the true Deity interposed in order to prevent a total and irrecoverable defection. Certain it is, that the species of idolatry which takes for the objects of its worship those natural agents, as it is the most ancient, so it is by far the most rational, and the most difficult to be disproved. It is much more difficult, for instance, to prove that the sun, which by his enlivening beams gives vigour to the whole creation, is not a deity, than that a log of wood is not one; and hence, if such a system of religion became universally established among mankind, it would be impossible ever afterwards to eradicate it. Indeed that the scheme of Babel, whatever it was, could have been put in execution by man, seems evident from the interposition of the Deity on the occasion; for we cannot suppose that he would have worked a miracle on purpose to defeat that which would have defeated itself if he had let it alone: and he expressly says, That now nothing could be restrained from them; which intimates very plainly, that, had this scheme gone on, the plan which God had laid for the government of the world would have been totally frustrated: and agreeable to this hypothesis Dr Tennison supposes that the tower was of a pyramidal form, in imitation of the spires of flame; and that it was erected in honour of the sun, as being the most probable cause of drying up the flood.

As to the materials made use of in the building of this tower, the Scripture informs us that they were bricks and slime or bitumen. According to an eastern tradition, three years were taken up in making the bricks, each of which was 13 cubits long, 10 broad, and five thick. Oriental writers say, that the city was 313 furlongs in length, and 151 in breadth; that the walls were 5533 fathoms high, and 33 in breadth; and that the tower itself was no less than 10,000 fathom, or 12 miles high. Even St Jerome affirms from the testimony of eye-witnesses, who as he says had examined the remains of the tower, that it was four miles high; but Ado makes the height to have been no less than 5000 miles. The only account of its dimensions which can be at all depended upon (supposing it to have been the same which afterwards stood in the midst of the city of Babylon, and round which Nebuchadnezzar built the temple of Belus), is that given under the article BABYLON.

BABEL-MANDEL, the GATE OF MOURNING; a famous strait in the Indian ocean, between the coast of Arabia Felix in Asia, and that of Adel and Zeila in Africa, at the entrance into the Red Sea. By some it is also called the *Straits of Moka*. It is narrow, and difficult to sail through, on account of the sand-banks.

See History of the "Bible"
" Dictionary of the Bible

Babenhausen || Babington.

At the mouth of the strait is a small island called also *Babel-Mandel*, which is little else than a barren rock. E. Long. 44. 30. N. Lat. 12. 40.

BABENHAUSEN, a town of Germany in Suabia. E. Long. 9. 16. N. Lat. 48. 39.

BABINA (*Commonwealth* of), a society ludicrously so called, which was founded in Poland in the reign of Sigismund-Augustus, in the 16th century. It took its rise from a set of gentlemen, inhabitants of Lublin, who had agreed to meet at a place called *Babina*, merely for the purposes of mirth and jollity. In time their number increased, and they formed themselves into a regular government, under the presidency of a king, senate, and chief magistrates. The magistrates were elected from something which appeared ridiculous in the character or conduct of any of the members. For instance, if any person was meddling or officious, he was immediately created an archbishop; a blundering or disputatious member was promoted to the speaker's chair; a boaster of his own courage, and vainglorious *Thraso*, was honoured with the commission of generalissimo, which was presented him with great ceremony by the subordinate heroes. Those who declined the office for which they were declared qualified, were persecuted with hissings, and abandoned by the society. Thus every vice and every foible was attacked with ridicule; and Babina became in a short time the terror, the admiration, and the reformer, of the Polish nation: genius flourished, wit was cultivated, and the abuses which had crept into government and society were corrected by the judicious application of good-humoured satire. Never did any institution of this nature become so general or so useful; but at length it degenerated into a seat of buffoons, and banterers of every thing sacred or profane. For several years it was patronised by the kings of Poland, and Sigismund himself became a member; the starosta of Babina telling him jocularly, That "His majesty had certain qualities which intitled him to the first dignity in the commonwealth." Not the least remnant of this society now remains, though it was honoured with extraordinary privileges by kings and emperors.

BABINGTON (Gervase), bishop of Worcester, was born, according to Fuller, in Nottinghamshire; but in what year is uncertain. He was sent to Trinity College, Cambridge, of which he was made fellow; and, in 1578, was incorporated master of arts at Oxford. He appears, however, to have made Cambridge the place of his residence, where he became an eminent preacher; and, being now doctor of divinity, was made domestic chaplain to Henry Earl of Pembroke. In this station he is supposed to have assisted the countess in her translation of the Psalms. In 1588 he was installed prebend of Hereford, and in 1591 consecrated bishop of Landaff. In 1594 he was translated to the see of Exeter, and thence to Worcester in 1597. About this time, or soon after, he was made queen's counsel for the marshes of Wales. He was a considerable benefactor to the library belonging to the cathedral of Worcester, where he was buried in May 1610 without a monument. The several historians who have mentioned this prelate agree in giving him the character of a learned and pious man. His writings, like those of most of his cotemporaries, abound with puns and quaint expressions. His works were printed both in folio and quarto in 1615, and again in folio in 1637, under this title; *The works of the right reverend father in God Gervaſe Babington, late biſhop of Worceſter, containing comfortable notes upon the five books of Moſes, viz.* *Geneſis, &c. As alſo an expoſition upon the Creed, the Ten Commandments, the Lord's Prayer; with a conference betwixt man's frailtie and faith, and three ſermons, &c.*

BABOON, in zoology. See Simia.

BABYLON, the capital of the ancient kingdom of Babylonia or Chaldæa, and ſuppoſed to have ſtood in E. Long. 44. 0. N. Lat. 32. 0. Semiramus is ſaid by ſome, and Belus by others, to have founded this city. But, by whomſoever it was founded, Nebuchadnezzar was the perſon who put the laſt hand to it, and made it one of the wonders of the world. The moſt famous works in and about it were the walls of the city, the temple of Belus, Nebuchadnezzar's palace, the hanging-gardens, the banks of the river, the artificial lake, and canals.

1 City deſcribed.

The city was ſurrounded with walls, in thickneſs 87 feet, in height 350 feet, and in compaſs 480 furlongs or 60 of our miles. Thus Herodotus, who was himſelf at Babylon; and though ſome diſagree with him in theſe dimenſions, yet moſt writers give us the ſame, or near the ſame, as he does. Diodorus Siculus diminiſhes the circumference of theſe walls very conſiderably, and takes ſomewhat from the height of them, as in Herodotus; tho' he ſeems to add to their breadth, by ſaying, that ſix chariots might drive abreaſt thereon; while the former writes, that one chariot only might turn upon them; but then he places buildings on each ſide of the top of theſe walls, which, according to him, were but one ſtory high; which may pretty well reconcile them together in this reſpect. It is obſerved, that thoſe who give the height of theſe walls but at 50 cubits, ſpeak of them only as they were after the time of Darius Hyſtaſpis, who had cauſed them to be beaten down to that level. Theſe walls formed an exact ſquare, each ſide of which was 120 furlongs, or 15 miles, in length; and were all built of large bricks cemented together with bitumen, which in a ſhort time grows harder than the very brick and ſtone which it cements. The city was encompaſſed, without the walls, with a vaſt ditch filled with water, and lined with bricks on both ſides; and, as the earth that was dug out of it ſerved to make the bricks, we may judge of the depth and largeneſs of the ditch from the height and thickneſs of the walls. In the whole compaſs of the wall there were 100 gates, that is, 25 on each of the four ſides, all made of ſolid braſs. Between every two of theſe gates, at proper diſtances, were three towers, and four more at the four corners of this great ſquare, and three between each of theſe corners and the next gate on either ſide, and each of theſe towers was ten feet higher than the walls. But this is to be underſtood only of thoſe parts of the walls where towers were needful for defence. For ſome parts of them being upon a moraſs, and inacceſſible by an enemy, there the labour and coſt was ſpared, which tho' it muſt have ſpoiled the ſymmetry of the whole, muſt be allowed to have ſavoured of good œconomy; though that is what one would not have expected from a prince who had been ſo determined, as Nebuchadnezzar muſt have been, to make the city complete both for ſtrength and beauty. The whole number, then, of theſe towers amounted to no more than 250; whereas a much greater number would have been neceſſary to have made the uniformity complete all round. From the 25 gates on each ſide of this ſquare, there was a ſtraight ſtreet, extending to the correſponding gate in the oppoſite wall; whence the whole number of the ſtreets muſt have been but 50; but then they were each about 15 miles long, 25 of them croſſing the other 25 exactly at right angles. Beſides theſe whole ſtreets, we muſt reckon four half-ſtreets, which were but rows of houſes facing the four inner ſides of the walls. Theſe four half-ſtreets were properly the four ſides of the city within the walls, and were each of them 200 feet broad, the whole ſtreets being about 150 of the ſame. By this interſection of the 50 ſtreets, the city was divided into 676 ſquares, each of four furlongs and a half on each ſide, or two miles and a quarter in compaſs. Round theſe ſquares on every ſide towards the ſtreets ſtood the houſes, all of three or four ſtories in height, and beautified with all manner of ornaments; and the ſpace within each of theſe ſquares was all void, and taken up by yards, or gardens, and the like, either for pleaſure or convenience.

A branch of the Euphrates divided the city into two, running through the midſt of it, from north to ſouth; over which, in the very middle of the city, was a bridge, a furlong in length, or rather more, and indeed much more, if we hearken to others, who ſay it was no leſs than five ſtades or furlongs in length, tho' but 30 feet broad, a difference we ſhall never be able to decide. This bridge, however, is ſaid to have been built with wonderful art, to ſupply a defect in the bottom of the river, which was all ſandy. At each end of this bridge were two palaces; the old palace on the eaſt ſide, the new one on the weſt ſide of the river; the former of which took up four of the ſquares abovementioned, and the latter nine. The temple of Belus, which ſtood next to the old palace, took up another of the ſame ſquares.

The whole city ſtood in a large flat or plain, in a very fat and deep ſoil: that part or half of it on the eaſt ſide of the river was the old city, and, the other on the weſt was added by Nebuchadnezzar, both being included within the vaſt ſquare bounded by the walls aforeſaid. The form of the whole was ſeemingly borrowed from Nineveh, which was alſo 480 furlongs; but though it was equal in dimenſions to this city, it was leſs with reſpect to its form, which was a parallelogram, whereas that of Babylon was an exact ſquare. It is ſuppoſed, that Nebuchadnezzar, who had deſtroyed that old ſeat of the Aſſyrian empire, propoſed that this new one ſhould rather exceed it; and that it was in order to fill it with inhabitants, that he tranſported ſuch numbers of the captives from other countries hither; though that is what may be diſputed, ſeeing he therein only followed the conſtant practice of the kings of Aſſyria, who thought this the moſt certain means of aſſuring their conqueſts either to themſelves or their poſterity.

2 Was never fully peopled.

But it plainly appears, that it was never wholly inhabited; ſo that, even in the meridian of its glory, it may be compared with the flower of the field, which flouriſhes to-day, and to-morrow is no more. It never had time to grow up to what Nebuchadnezzar viſibly intended to have made it; for, Cyrus removing the

the seat of the empire soon after to Shushan, Babylon fell by degrees to utter decay; yet it must be owned, that no country was better able to support so vast and populous a city, had it been completed up to its first design. But so far was it from being finished according to its original design, that, when Alexander came to Babylon, Q. Curtius tells us, "No "more than 90 furlongs of it were then built:" which can be no otherwise understood, than of so much in length; and, if we allow the breadth to be as much as the length (which is the utmost that can be allowed), it will follow, that no more than 8100 square furlongs were then built upon: but the whole space within the walls contained 14,400 square furlongs; and therefore there must have been 6300 square furlongs remaining unbuilt, which, Curtius tells us, were plowed and sown. And, besides this, the houses were not contiguous, but all built with a void space on each side, between house and house.

3
Temple of Belus.

The next great work of Nebuchadnezzar was the temple of Belus. The wonderful tower, however, that stood in the middle of it, was not his work, but was built many ages before; that, and the famous tower of Babel, being as is commonly supposed, one and the same structure. This tower is said to have been composed of eight pyramidal ones raised above one another, and by Herodotus said to have been a furlong in height, but as there is an ambiguity in his expression, it has been disputed whether each of the towers was a furlong in height, or the whole of them taken together. On the latter supposition, which is the most probable, this tower must have exceeded the highest of the Egyptian pyramids by 179 feet, though it fell short of its breadth at the basis by 33. The way to go up was by stairs on the outside round it; whence it seems most likely, that the whole ascent was, by the benching in, drawn in a sloping line from the bottom to the top eight times round it; and that this made the appearance of eight towers, one above the other. Till the times of Nebuchadnezzar, it is thought that this tower was all the temple of Belus; but as he did by the other ancient buildings of the city, so he did by this, making great additions thereto, by vast edifices erected round it, in a square of two furlongs on every side, and just a mile in circumference, which exceeded the square at the temple of Jerusalem by 1800 feet. On the outside of these buildings was a wall, which inclosed the whole; and, in consideration of the regularity wherewith this city was to all appearance marked out, it is supposed that this wall was equal to the square of the city wherein it stood, and so is concluded to have been two miles and an half in circumference. In this wall were several gates leading into the temple, and all of solid brass; which it is thought may have been made out of the brasen sea, and brasen pillars, and other vessels and ornaments of the kind, which Nebuchadnezzar had transported from Jerusalem; for in this temple he is said to have dedicated his spoils from that of Jerusalem.

4
Idols of gold, &c.

In this temple were several images or idols of massy gold, and one of them, as we have seen 40 feet in height; the same, as supposed, with that which Nebuchadnezzar consecrated in the plains of Dura. For though this last is said to have been 60 cubits, or 90 feet high, these dimensions appear so incredible, that it has been attempted to reconcile them into one, by supposing that in the 90 feet the height of the pedestal is included, and that the 40 feet are for the height of the statue without the pedestal; and, being said to have weighed 1000 talents of Babylon, it is thence computed, that it was worth three millions and an half of our money. In a word, the whole weight of the statues and decorations, in Diodorus Siculus, amounting to 5000 and odd talents in gold, the whole is estimated at above one and twenty millions of our money; and a sum about equal to the same, in treasure, utensils, and ornaments, not mentioned is allowed, for.

Next to this temple, on the east side of the river, stood the old palace of the kings of Babylon, being four miles in circumference. Exactly opposite to it, on the other side of the river, was the new palace built by Nebuchadnezzar, eight miles in cirumference, and consequently four times as big as the old one.

5
Hanging gardens.

But nothing was more wonderful at Babylon than the hanging gardens, which Nebuchadnezzar made in complaisance to his wife Amyte; who, being a Mede, and retaining a strong inclination for the mountains and forests of her own country, was desirous of having something like them at Babylon. They are said to have contained a square of four plethra, or 400 feet, on each side; and to have consisted of terraces one above another, carried up to the height of the wall of the city, the ascent from terrace to terrace being by steps ten feet wide. The whole pile consisted of substantial arches upon arches, and was strengthened by a wall surrounding it on every side, 22 feet thick; and the floors on each of them were laid in this order: first, on the tops of the arches was laid a bed or pavement of stones 16 feet long, and four feet broad; over this was a layer of reed mixed with a great quantity of bitumen; and over this two courses of brick, closely cemented together with plaster; and over all these were thick sheets of lead, and on these the earth or mould of the garden. This floorage was designed to retain the moisture of the mould; which was so deep, as to give root to the greatest trees which were planted upon every terrace, together with great variety of other vegetables pleasing to the eye. Upon the uppermost of these terraces was a reservoir, supplied by a certain engine with water from the river, from whence the gardens on the other terraces were supplied.

6
Banks of the river, canals, &c.

The other works attributed to Nebuchadnezzar by Berosus and Abydenus, were the banks of the river, the artificial canals, and the great artificial lake said to have been sunk by Semiramis. The canals were cut out on the east side of the Euphrates, to convey the waters of that river, when it overflowed its banks, into the Tigris, before they reached Babylon. The lake was on the west side of Babylon; and, according to the lowest computation, 40 miles square, 160 in compass, and in depth 35 feet, as we read in Herodotus, or 75, as Megasthenes will have it; the former, perhaps, measured from the surface of the sides, and the latter from the tops of the banks that were cast up upon them. This lake was dug to receive the waters of the river, while the banks were building on each side of it. But both the lake, and the canal which led to it, were preserved after that work was completed, being found of great use, not only to prevent

vent all overflowings, but to keep water all the year, as in a common reservoir, to be let out on proper occasions, by sluices, for the improvement of the land.

The banks were built of brick and bitumen, on both sides of the river, to keep it within its channel; and extended on each side throughout the whole length of the city, and even farther, according to some, who reckon they extended 160 furlongs, or twenty miles; whence it is concluded they must have begun two miles and an half above the city, and have been continued an equal distance below it, the length of the city being no more than 15 miles. Within the city they were built from the bottom of the river, and of the same thickness with the walls of the city itself. Opposite to each street, on either side of the river, was a brazen gate in the said wall, with stairs leading down from it to the river: these gates were open by day, and shut by night.

Berosus, Megasthenes, and Abydenus, attribute all these works to Nebuchadnezzar; but Herodotus tells us, the bridge, the banks, and the lake, were the work of a queen after him, called *Nitocris*, who may have finished what Nebuchadnezzar left imperfect, and thence have had the honour this historian gives her of the whole.

The tower or temple stood till the time of Xerxes. But that prince on his return from the Grecian expedition, having first plundered it of its immense wealth, demolished the whole, and laid it in ruins. Alexander, on his return to Babylon from his Indian expedition, proposed to rebuild it, and accordingly set 10,000 men on work to clear away the rubbish. But his death happening soon after, a stop was put to all further proceedings in that design. After the death of that conqueror, the city of Babylon began to decline apace; which was chiefly owing to the neighbourhood of Seleucia, built by Seleucus Nicator, as is said, out of spite to the Babylonians, and peopled with 500,000 persons drawn from Babylon, which by that means continued declining till the very people of the country were at a loss to tell where it had stood.

Such is the description we have by ancient historians of the grandeur of this city; which, if these accounts are not exaggerated, must have exceeded every piece of human grandeur that hath yet appeared. Many of the moderns, however, are of opinion that these magnificent descriptions are very far from being true; although it is certain that few other arguments can be brought against the reality of them, than that we do not see things of a similar kind executed in our own days. The following are the arguments used on this subject by the president Goguet.

7
Goguet's arguments against the truth of the foregoing relation.

"Authors have greatly extolled the public works and edifices which once rendered Babylon one of the wonders of the world. We may reduce all these objects to five principal heads; 1. The height of its walls; 2. the temple of Belus; 3. the hanging gardens; 4. the bridge built over the river Euphrates, and the quays which lined that river; 5. the lake and canals dug by the hands of man to distribute the waters of the Euphrates.

"All these works so marvellous in the judgment of antiquity, appear to me to have been extremely exaggerated by the authors who have spoken of them. How can we conceive, in effect, that the walls of Babylon could have been 318 feet high, and 81 in thickness, in a compass of near ten leagues?

"I shall say the same of that square building, known under the name of *the temple of Belus*. It was composed of eight towers placed one above another, diminishing always as they went up. Herodotus does not tell us what was the height of this monument. Diodorus says, that it surpassed all belief. Strabo fixes it at one stadium, a measure which answers nearly to 600 of our feet. For in the time of this geographer the stadia were much more considerable than in the first ages. The entire mass of this building ought to have been answerable its excessive height; and this is also the idea that the ancients designed to give us of it. We may judge by the following fact. Xerxes had entirely demolished this temple. Alexander undertook to rebuild it. He designed to begin by clearing the place and removing the ruins. Ten thousand workmen who were employed two months in this work, were not, say they, able to finish it.

"The riches inclosed in the temple of Belus were proportioned to its immensity. Without speaking of the tables and censers, the cups, and other sacred vases, of massy gold, there was a statue 40 feet high, which alone weighed 1000 Babylonish talents. In short, according to the inventory that the ancients have given us of the riches contained in this temple, the total sum would amount to two hundred and twenty millions and a half of French livres. Exaggerations like these destroy themselves.

"As to the hanging gardens, according to all appearance they never existed. The silence of Herodotus on a work so singular and so remarkable, determines me to place in the rank of fables all that the other writers have delivered upon this pretended wonder. Herodotus had carefully visited Babylon. He enters into such details as prove that he has omitted none of the rarities of that city. Can we presume that he would have passed over in silence such a work as the hanging gardens? All the authors who have spoken of it are of much later date than this great historian. None of them except Berosus speaks on his own testimony. It is always on the report of others. Diodorus had extracted from Ctesias what he says of these famous gardens. There is also great appearance that Strabo had drawn from the same source. In a word, the manner in which Quintus Curtius expresses himself, sufficiently shows how much the existence of these gardens appeared to him suspicious. He judged they owed the greatest part of it to the imagination of the Greeks.

"Let us now speak of the bridge of Babylon, which the ancients have placed in the number of the most marvellous works of the east. It was near 100 fathoms in length, and almost four in breadth. We cannot deny but that a great deal of art and labour was necessary to lay the foundations, which it could not be easy to settle in the bed of an extremely deep and rapid river, which also rolls along a prodigious quantity of mud, and whose bottom is entirely sandy. They had therefore taken many precautions to secure the piers of the bridge of Babylon. They were built of stones joined and fastened together with cramps of iron, and their joints filled with melted lead. The front of the piers, turned towards the current of the Euphrates, was

was defended by buttresses extremely advanced, which diminished the weight and force of the water, by cutting it at a great distance. Such was the bridge of Babylon.

"While we do justice to the skill of the Babylonians in conducting these works, we cannot help remarking the bad taste which at all times reigned in the works of the eastern nations. The bridge of Babylon furnishes a striking instance of it. This edifice was absolutely without grace, or any air of majesty. The breadth of it was in no sort of proportion to its length. The distance between the piers was also very ill contrived. They were distant from each other only 11 feet and a half. Finally, this bridge was not arched. We may judge of its effect on the view.

"The Babylonians, however, were not the only people who were ignorant of the art of turning an arch. This secret, as far as I can find, was unknown to all the people of remote antiquity, who, generally speaking, do not appear to have been very skilful in stone-cutting.

"As for the quays which lined the Euphrates, we may believe that they were grand and magnificent: but I shall not easily believe that they surpassed those which we have daily under our eyes. In this respect, I believe Paris may dispute it for magnificence, and for the extent of the work, with all the cities of the universe."

Babylon, a town of Egypt near the eastmost branch of the river Nile, now supposed to be *Grand Cairo*, or this city to stand near its ruins. E. Long. 31. 12. N. Lat. 30. 5.

BABYLONIA, or Chaldæa, a kingdom of Asia and the most ancient in the world, being founded by Nimrod the grandson of Ham, who also, according to the margin of our Bibles, founded Nineveh the capital of the kingdom of Assyria. Indeed, these two kingdoms seem to have always continued in such a state of friendship, that we can scarce help thinking they must have been the same, or perhaps Babylonia was for some time a province of Assyria. Nothing certain is known concerning either of them, except what may be gathered from Scripture. From thence we learn, that in the days Abraham there was a king of *Shinar*, called *Amraphel*, who, under the king of Elam or Persia made war upon the Canaanites. From this time we have nothing that can be depended upon till the days of Nabonassar, the first king of Babylon mentioned in Ptolemy's canon. It is plain indeed, both from Scripture and profane history, that Babylonia subsisted as a distinct kingdom from Assyria even when the latter was in all its glory. The most probable account of the matter is this: The empire of Assyria was founded by Pul, on the ruins of that of Damascus or Syria, in the days of Menahem king of Judah. This king left two sons, Tiglath-Pileser, and Nabonasser. To the former he bequeathed the empire of Assyria, and to the latter that of Babylon. Tiglath-Pileser resided at Nineveh, the original seat of the Assyrian empire; while Nabonasser, who was the younger brother, held his residence at Babylon. As the two kingdoms were governed by princes of the same family, we may well suppose a perfect harmony to have reigned between them, the younger branch at Babylon acknowledging a kind of subjection to the elder at Nineveh. That the Babylonian empire was of Assyrian origin, we are assured by the prophet Isaiah, in the following words: "Behold the land of the Chaldeans: this people was not till the Assyrian founded it for them that dwelt in the wilderness; they set up the towers thereof: they built the palace thereof." As to the kingdom of Assyria, the Scripture mentions only five kings, *viz.* Pul, Tiglath-Pileser, Shalmanaser, Sennacharib, and Esarhaddon; whose history, as related by the sacred writers, it is needless to mention particularly here. From the days of Nabonasser, to Nabopolasser, that is, from the year before Christ 747 to 626, the kings of Babylon made no figure, and were therefore probably in a state of dependence on the kings of Assyria; but at that time, in the reign of *Chyniladan*, the Sardanapalus of the Greeks, Nineveh was taken and destroyed by the Medes and Babylonians, and the seat of the empire transferred to Babylon. This Nabopolasser was the father of the famous Nebuchadnezzar, for whose history we must refer to the sacred writers: and from his time to that of the *Belshazzar* of Daniel, and *Nabonadius* of other authors, the history of Babylon is little better than a mere blank. Of the reduction of Babylon by Cyrus, which happened at this time, we have the following account.

War had been begun betwixt the Medes, Persians, and Babylonians, in the reign of Neriglissar the father of Nabonadius, which had been carried on with very bad success on the side of the Babylonians. Cyrus, who commanded the Median and Persian army, having subdued the several nations inhabiting the great continent from the Ægean sea to the Euphrates, bent his march towards Babylon. Nabonadius, hearing of his march, immediately advanced against him with an army. In the engagement which ensued, the Babylonians were defeated; and the king, retreating to his metropolis, was blocked up and closely besieged by Cyrus. The reduction of this city was no easy enterprise. The walls were of a prodigious height, the number of men to defend them very great, and the place stored with all sorts of provisions for 20 years. Cyrus, despairing of being able to take such a city by storm, caused a line of circumvallation to be drawn quite round it, with a large and deep ditch; reckoning, that if all communication with the country were cut off, the besieged would be obliged to surrender through famine. That his troops might not be too much fatigued, he divided his army into twelve bodies, appointing each body its month to guard the trenches; but the besieged, looking upon themselves to be out of all danger by reason of their high walls and magazines, insulted him from the ramparts, and looked upon all the trouble he gave himself as so much unprofitable labour.

After Cyrus had spent two whole years before Babylon, without making any progress in the siege, he at last thought of the following stratagem, which put him in possession of it. He was informed, that a great annual solemnity was to be held at Babylon; and that the inhabitants on that occasion were accustomed to spend the whole night in drinking and debauchery. This he therefore thought a proper time for surprising them; and accordingly sent a strong detachment to the head of the canal leading to the great lake, with orders, at a certain time, to break down the great bank which was between the lake and the canal, and to turn the whole current into the lake. At the same time he appointed one body of troops at the place where the river entered the city, and another where it came out; ordering them to march in by the bed of the river as soon as they should find it fordable. Towards the evening he opened the head of the trenches on both sides the river above the city, that the water might discharge itself into them; by which means, and the breaking down of the great dam, the river was soon drained. Then the two abovementioned bodies of troops, according to their orders, entered the channel; the one commanded by Gobryas and the other by Gadates: and finding the gates all left open by reason of the disorders of that riotous night, they penetrated into the very heart of the city without opposition; and meeting, according to agreement, at the palace, they surprised the guards, and cut them in pieces. Those who were in the palace opening the gates to know the cause of this confusion, the Persians rushed in, took the palace, and killed the king, who came out to meet them sword in hand. Thus an end was put to the Babylonian empire; and Cyrus took possession of Babylon for one called in Scripture *Darius the Mede*, most probably *Cyaxares* II. uncle to Cyrus. From this time Babylonia never was erected into a distinct kingdom, but hath always followed the fortune of those great conquerors who at different times have appeared in Asia. It is now frequently the object of contention between the Turks and Persians. See ASSYRIA.

Concerning the nature of the country, manners, customs, &c. of the ancient Babylonians, the following account is collected by M. Sabbathier.

"As all the nations under the dominion of Cyrus, beside the ordinary tributes, were obliged to maintain him and his army, the monarch and his troops were supported by all Asia. The country of Babylon alone was obliged to maintain him four months of the year; its fertility, therefore, yielded a third of the produce of Asia. The government of this country, which the Persians termed *satrapy*, was richer, and more extensive, than any of the rest. It maintained for the king, besides the war-horses, a stud of 800 stallions, and 16,000 mares. So great a number of Indian dogs were likewise bred in this province for the king, that four of its cities kept those animals; and in return, they were exempted from all taxes and tributes.

"It rained very seldom in this country, according to Herodotus. The earth was watered by the river, which was here diffused by human industry, as the Nile is over Egypt by nature: for all the country of Babylon was divided by canals, the greatest of which was navigable, and flowed from south to north, from the Euphrates to the Tigris. In short, it was one of the finest countries for corn in the world; but for producing trees, the fig-tree, the vine and the olive, it was not famous. It was so luxuriant in grain, that it commonly yielded a hundred times more than what was sown; and in its good years it yielded three hundred times more than it received. The leaves of its wheat and barley were four inches broad. 'Though I know,' says Herodotus, 'that the millet and the sesame of that country grow to the size of trees, I will not describe them particularly; lest those who have not been in Babylonia should think my account fabulous.'

"They had no oil but what they made from Indian corn. The country abounded with palm-trees, which grew spontaneously; and most of them bore fruit, of which the inhabitants made bread, wine, and honey. They cultivated these trees and their fig-trees in the same manner. Some of them, as of other trees, the Greeks called *male ones*. They tied the fruit of the male to the trees which bore dates; that the mosquito, leaving the male, might cause the date to ripen, by penetrating it; for without that assistance it came not to maturity. Mosquitos bred in the male palms as in the wild fig-trees.

"But we must not here omit to give an account of the peculiar and surprising construction of their boats of skins, in which they sailed along the river to Babylon. These boats were invented by the Armenians, whose country lay north from Babylonia. They made them with poles of willow, which they bent, and covered with skins: the bare side of the skins they put outwards; and they made them so tight, that they resembled boards. The boats had neither prow nor stern, but were of a round form like a buckler. They put straw on the bottom. Two men, each with an oar, rowed them down the river, laden with different wares, but chiefly with palm-wine. Of these boats some were very large, and some very small. The largest carried the weight of 500 talents. There was room for an ass in one of their small boats; they put many into a large one. When they had unloaded, after their arrival at Babylon, they sold the poles of their boats and the straw; and loading their asses with the skins, returned to Armenia: for they could not sail up the river, its current was so rapid. For this reason they made their boats of skins, instead of wood; and on their return to Armenia with their asses, they applied the skins to their former use.

"As to their dress, they wore a linen shirt, which came down to their feet. Over it they wore a woollen robe; their outer garment was a white vest. Their shoes resembled those of the Thebans. They let their hair grow. On their heads they wore a turban. They rubbed their bodies all over with fragrant liquors. Each man had a ring on his finger, and an elegant cane in his hand, with an apple at the top, or a rose, a lily, or an eagle, or some other figure; for they were not suffered to use canes without devices.

"With regard to their policy, Herodotus thinks that their best law was one which the Heneti, an Illyrian people, likewise observed in every town and village. When the girls were marriageable, they were ordered to meet in a certain place, where the young men likewise assembled. They were then sold by the public crier; but he first sold the most beautiful one. When he had sold her at an immense price, he put up others to sale, according to their degrees of beauty. The rich Babylonians were emulous to carry off the finest women, who were sold to the highest bidders. But as the young men who were poor could not aspire to have fine women, they were content to take the ugliest with the money which was given them: for when the crier had sold the handsomest, he ordered the ugliest of all the women to be brought; and asked, if any one was willing to take her with a small sum of money. Thus she became the wife of him who was most easily satisfied; and thus the finest women were sold; and from the money

money which they brought, small fortunes were given to the ugliest, and to those who had any bodily infirmity. A father could not marry his daughter as he pleased; nor was he who bought her allowed to take her home, without giving security that he would marry her. But, after the sale, if the parties were not agreeable to each other, the law enjoined that the purchase-money should be restored. The inhabitants of any of their towns were permitted to marry wives at these auctions. Such were the early customs of the Babylonians.

"But they afterwards made a law, which prohibited the inhabitants of different towns to intermarry, and by which husbands were punished for treating their wives ill. When they had become poor by the ruin of their metropolis, fathers used to prostitute their daughters for gain. There was a sensible custom among the Babylonians, worthy to be related. They brought their sick into the forum, to consult those who passed on their diseases; for they had no physicians. They asked those who approached the sick, if they ever had the same distemper? if they knew any one who had it? and how he was cured? Hence, in this country, every one who saw a sick person was obliged to go to him, and inquire into his distemper.

"They embalmed their dead with honey; and their mourning was like that of the Egyptians.

"There were three Babylonian tribes, who lived only upon fish, and who prepared them in the following manner: they dried them in the sun, and then beat them in a mortar to a kind of flour, which after they had sifted through linen, they baked it in rolls.

"The Babylonians at first worshipped only the sun, and the moon; but they soon multiplied their divinities. They deified Baal, Bel, or Belus, one of their kings, and Merodach-Baladan. They also worshipped Venus, under the name of *Mylitta*. She and Belus were the principal deities of the Babylonians. They counted their day from sun-rise to sun-rise. They solemnized five days of the year with great magnificence, and almost the same ceremonies with which the Romans celebrated their Saturnalia.

"The Babylonians were very much addicted to judicial astrology. Their priests, who openly professed that art, were obliged to commit to writing all the events of the lives of their illustrious men; and on a fancied connection between those events and the motions of the heavenly bodies, the principles of their art were founded. They pretended that some of their books, in which their historical transactions and revolutions were accurately compared with the courses of the stars, were thousands of years old. This assertion of their judicial astrologers we may reasonably dispute; but that their astronomers had made a long series of observations, is incontestably true. It is certain that some of those observations were extant in the days of Aristotle, and that they were older than the empire of the Babylonians. See *History of* ASTRONOMY.

BABYLONIAN, BABYLONIUS, is used in some ancient writers, for an astrologer, or any thing related to astrology. Hence *Babylonia cura*, the art of casting nativities; and *numeri Babylonii*, the computation of astrologers.

BABYLONICA TEXTA, a rich sort of weavings, or hangings, denominated from the city of Babylon, where the practice of interweaving divers colours in their hangings first obtained. Hence also Babylonic garments, Babylonic skins, Babylonic carpets, housings, &c. *Babylonica solana*, coverings laid over couches, &c. painted with gold, purple, and other colours.

BABYLONICS, BABYLONICA, in ancient history, a fragment of the history of the world, ending at 267 years before Christ; and composed by Berosus, or Berossus, a priest of Babylon, about the time of Alexander. Babylonics are sometimes also cited in ancient writers by the title of *Chaldaics*. The Babylonics were very consonant with scripture, as Josephus and the ancient Christian chronologers assure; whence the author is usually supposed to have consulted the Jewish writers. Berosus speaks of an universal deluge, an ark, &c. He reckons ten generations between the first man and the deluge; and marks the duration of the several generations by *saroi*, or periods of 223 lunar months; which, reduced to years, differ not much from the chronology of Moses.—The babylonics consisted of three books, including the history of the ancient Babylonians, Medes, &c. But only a few imperfect extracts are now remaining of the work; preserved chiefly by Josephus and Syncellus, where all the passages of citations of ancient authors out of Berosus are collected with great exactness, Annius of Viterbo, to supply the loss, forged a complete Berosus out of his own head. The world has not thanked him for the imposture.

BABYROUSSA, in zoology, a synomine of a species of sus. See SUS.

BAC, in navigation, is used for a praam, or ferry-boat.

BAC, in brewing, a large flat kind of tub, or vessel, wherein the wort is put to stand and cool before boiling. The ingredients of beer pass through three kinds of vessels. They are masked in one, worked in another, and cooled in a third, called *bacs* or *coolers*.

BAC, in distillery, vessels into which the liquor to be fermented is pumped from the cooler, in order to be worked with the yest.

BAC-Maker, is one who makes liquor-bacs, underbacs, coolers, mash-tons, working-tons, &c. for the brewers. The workmanship is partly carpentry, in a particular manner, for it must be tight enough to hold liquor; and partly cooperage, *viz.* the mash-tun, or vat, which is hooped. There are not many of this trade; and it requires chiefly strength, with a little art. A small stock of stuff, besides tools, will set a man up tolerably well; but, with 200l. or 300l. he will make a good figure in business.

BACA, or BAZA, a town of Spain, in the kingdom of Granada. W. Long. 3. 6. N. Lat. 37. 18. It is situated in a valley called *Hoya de Baza*. It is encompassed with old walls, and has a castle half ruined. It contains about 4000 houses, but has nothing remarkable except the church dedicated to the Virgin Mary. The land about it is well cultivated for half a league round, and is fertile in wheat, wine, honey, hemp, and flax, being watered by the little river Guadalantin.

BACACUM, a town of the Nervii in Gallia Belgica; now *Bavay*, in Hainault. E. Long. 3. 30. N. Lat. 50. 25.

BACAIM, a handsome sea-port town of the kingdom of Visapour on the Malabar coast in Asia. It is subject to the Portuguese; and stands in E. Long. 73. 10. N. Lat. 19. 0.

BACASERAY, a town in the peninsula of Crim Tartary, and, as the khan usually takes up his residence there, it may be considered as the capital of the country. E. Long. 35. 10. N. Lat. 45. 30.

BACCA, BERRY, in botany, is used to signify such fruits as consist of a pericarpium full of juice and seeds, without any valves.

BACANTIBI, in ecclesiastical antiquity, wandering clerks, who strolled from church to church.—— The word seems formed by corruption from *vacantivi*.

BACCALARIA, in middle age writers, denotes a kind of country-farms, consisting of several manses.

Bacalaria dominicaria, or *indominicata*, was more particularly used for a farm belonging to the lord, and kept in his own hands.

BACCARACH, a town of Germany in the lower Palatinate; formerly imperial and free, but now subject to the elector Palatine. It is famous for excellent wine; and is situated on the Rhine, in E. Long. 7. 5. N. Lat. 49. 57.

BACCHÆ, in antiquity, the priestesses of Bacchus, who celebrated the *orgia*, or mysteries of that god.— The word was also used for the ivy crowns or garlands worn by the priests of Bacchus, in offering sacrifices to him.

BACCHANALIA, feasts celebrated in honour of Bacchus by the ancients. The two most remarkable were called the *greater* and *lesser*. The latter, called *lenæa*, from a word signifying a *wine-press*, were held in the open fields about autumn; the greater, called *Dionysia*, from one of the names of Bacchus, were celebrated in the city, about the spring-time. Both these feasts were accompanied with games, spectacles, and theatrical representations, and it was at this time the poets contended for the prize of poetry. Those who were initiated into the celebration of these feasts, represented some Silenius; others, Pan; others, Satyrs; and in this manner appeared in public, night and day, counterfeiting drunkenness, dancing obscenely, and committing all kinds of licentiousness and debauchery. See the article Bacchus.

BACCHARIS, PLOUGHMAN'S SPIKENARD: A genus of the polygamia superflua order, belonging to the syngenesia class of plants; and in the natural method ranking under the 49th order, *Compositæ discoides*. The characters are: It has a naked receptacle, and hairy papus; with a cylindrical imbricated calyx, and feminine florets mixed with the hermaphrodite ones. There are seven species, all natives of warm climates; but none of them merit notice except the two following. 1. The ivæfolia, or African tree-groundsel, is a native of the Cape of Good Hope, as also of Peru and other warm parts of America. It grows to the height of five or six feet; and though there is little beauty in the flower, has been long admitted into the gardens of the curious. It is pretty hardy, and will live abroad in moderate winters in England, but is usually kept in green-houses and placed abroad only in summer. It may be propagated either by cuttings or seeds, which ripen well in this country. 2. The Halimifolia, or Virginia groundsel-tree, is a native of Virginia and other parts of North-America. It grows about seven or eight feet high, with a crooked shrubby stem; and flowers in October: the flowers are white, and not very beautiful; but the leaves continuing green, has occasioned this shrub to be admitted into many curious gardens. It may be propagated by cuttings; and will live very well in the open air, though severe frosts will sometimes destroy it.

BACCHI, in mechanics, a kind of ancient machines, in form of goats, used by Jupiter, in his wars against the giants. Rudbeck describes two kinds of bacchi, one made like the battering-ram, wherewith Jupiter demolished the enemy's fortifications; the other contrived to cast fire out of, from whence the Greeks are conjectured to have framed their idea of chimera.

BACCHIC, something relating to the ceremonies of Bacchus. The celebrated *intaglio*, called Michael Angelo's ring, is a representation of a bacchic feast.

Bacchic song, is sometimes used for a *chanson à boire*, or composition to inspire jollity. But in a more proper sense, it is restrained to a dithyrambic ode or hymn.

BACCHINI (Benedict), a Benedictine monk, and one of the most learned men in his time, was born at Borgo San Domino in 1651; and wrote a great number of books in Latin and Italian, the most considerable of which is a Literary Journal. He died at Bologna in 1721, aged 70.

BACCHIUS, a follower of Aristoxenus, supposed by Fabricius to have been tutor to the emperor Marcus Antoninus, and consequently to have lived about A. C. 140. He wrote in Greek a very short introduction to music in dialogue, which, with a Latin translation thereof, Meibomius has published. It seems it was first published in the original by Mersennus, in his Commentary on the first six chapters of Genesis; and that afterwards he published a translation of it in French, which Meibomius, in the preface to his edition of the ancient musical authors, censures as being grossly erroneous.

Bacchius, in ancient poetry, a kind of foot composed of a short syllable, and two long ones; as the word [ăvārī]. It takes its name from the god Bacchus, because it frequently entered into the hymns composed in his honour. The Romans called it likewise *ænotrius*, *tripodius*, *saltans*.

BACCHUS, in Heathen mythology, the god of wine, with whose fabulous adventures every school-boy is acquainted. This personage is seldom named in modern times, but as a sensual encourager of feast and jollity; but he was regarded in a more respectable light by the ancients, who worshipped him in different countries under the following appellations: In Egypt, he was called *Osiris*; in Mysia, *Fanaces*; in India; *Dionysius*; *Liber*, throughout the Roman dominions; *Adoneus*, in Arabia; and *Pentheus*, by the Lucanians. Mythologists furnish reasons for all these different names given to the same god, which may be seen in the second volume of Banier's Mythology.

It is natural to suppose that the Greeks and Romans, as usual, bestowed upon the one Bacchus which they wor-

worshipped, the several actions and attributes of the many divinities known by that name, and by other equivalent denominations in different countries. However, antiquity chiefly distinguished two gods under the title of *Bacchus:* that of Egypt, the son of Ammon, and the same as Osiris; and that of Thebes in Bœotia, the son of Jupiter and Semele.

The Egyptian Bacchus was brought up at Nysa, a city of Arabia Felix, whence he acquired the name of *Dionysius*, or the God of Nysa; and this was the conqueror of India. Though this Bacchus of the Egyptians was one of the elder gods of Egypt, yet the son of Semele was the youngest of the Grecian deities. Diodorus Siculus tells us, that Orpheus first deified the son of Semele by the name of Bacchus, and appointed his ceremonies in Greece, in order to render the family of Cadmus, the grandfather of the Grecian Bacchus, illustrious.

The great Bacchus, according to Sir Isaac Newton, flourished but one generation before the Argonautic expedition. This Bacchus, says Hermippus, was potent at sea, conquered eastward as far as India, returned in triumph, brought his army over the Hellespont, conquered Thrace, and left music, dancing, and poetry there. And, according to Diodorus Siculus, it was the son of Semele who invented farces and theatres, and who first established a music-school, exempting from all military functions such musicians as discovered great abilities in their art; on which account, says the same author, musicians formed into companies have since frequently enjoyed great privileges.

Dr Burney * observes, that the dithyrambics which gave birth to dramatic representations, are as ancient as the worship of Bacchus in Greece; and there is little doubt but that the ceremonies of his mysteries gave rise to the pomp and illusions of the theatre. Many of the most splendid exhibitions upon the stage for the entertainment of the people of Athens and Rome, being performed upon the festivals of Bacchus, gave occasion to the calling all those that were employed in them, whether for singing, dancing, or reciting, *servants of Bacchus*.

* *History of Music.* p. 298. *et seq.*

Pausanias, in his Attics, speaks of a place at Athens consecrated to *Bacchus the singer;* thus named, he says, for the same reason as Apollo is called the *chief* and *conductor* of the muses. Whence it should seem that Bacchus was regarded by the Athenians not only as the god of wine, but of song; and it must be owned, that his followers, in their cups, have been much inclined to singing ever since. Indeed we are certain, that in none of the orgies, processions, triumphs, and festivals, instituted by the ancients to the honour and memory of this prince of *bons vivans*, music was forgotten, as may be still gathered from ancient sculpture, where we find not only that musicians, male and female, regaled him with the lyre, the flute, and with song; but that he was accompanied by fawns and satyrs playing upon timbrels, cymbals, bagpipes, and horns: these Suidas calls his minstrels; and Strabo gives them the appellations of *Bacchi*, *Sileni*, *Satyri*, *Bacchæ*, *Lenæ*, *Thyæ*, *Mamillones*, *Naiades*, *Nymphæ*, and *Tityri*. These representations have furnished subjects for the finest remains of ancient sculpture; and the most voluptuous passages of ancient poetry are descriptions of the orgies and festivals of Bacchus. See ORGIA.

BACCHYLIDES, a famous Greek poet, was the nephew of Simonides, and the cotemporary and rival of Pindar. Both sung the victories of Hiero at the public games. Besides odes to athletic victors, he was author of Love Verses; Prosodies; Dithyrambics; Hymns; Pæans; Hyporchemes, Parthenia, or songs to be sung by a chorus of virgins at festivals. The chronology of Eusebius places the birth of Bacchylides in the 82d Olympiad, about 450 B. C.

BACCIO, or BACCIUS, (Andrew), a celebrated physician of the 16th century, born at St Elpideo. He practised physic at Rome with great reputation, and was first physician to pope Sixtus V. The most scarce and valuable of his works are, 1. *De thermis*. 2. *De naturali vinorum historia*. 3. *De venenis et antidotis*. 4. *De gemmis ac lapidibus pretiosis*.

BACCIO (Fra. Bartolomeo), called *Bartolemi di S. Marco*, a celebrated painter of history and portrait, was born at Savignano near Florence in 1469, and was a disciple of Cosimo Roselli; but his principal knowledge in the art of painting was derived from Leonardo da Vinci. He understood the true principles of design better than most masters of his time, and was also a considerable painter in perspective; which induced Raphael to have recourse to him after he had quitted the school of Perugino; and under his direction likewise Raphael studied the art of managing and uniting colours, as well as the rules of perspective. Some years after the departure of Raphael from Florence, Baccio visited Rome; and by the observations he made on the antiques, and the works of Raphael which were then the admiration of the whole world, he was extremely improved, and manifested his acquired abilities by a picture of S. Sebastian, which he finished at his return to Florence. It was so well designed, so naturally and beautifully coloured, and had so strong an expession of pain and agony, that it was removed from the place where it was publicly seen (in the chapel of a convent), as it had been observed to have made too strong an impression on the imaginations of many women who beheld it. He was very laborious, and made nature his perpetual study; he designed the naked correctly; his figures had a great deal of grace, and his colouring was admirable. He is accounted to have been the first inventor of that machine called a *layman* by the artists, and which to this day is in general use. Upon that he placed his draperies, to observe with greater exactness their natural and their more elegant folds. A capital picture of the ascension by Baccio, is in the Florentine collection. He died in 1517.

BACHELOR, or BATCHELOR, a common term for a man not married, or who is yet in a state of celibacy.—The Roman censors frequently imposed fines on old bachelors. Dion Halicarnasseus mentions an old constitution, by which all persons of full age were obliged to marry. But the most celebrated law of this kind was that made under Augustus, called the *lex Julia de maritandis ordinibus*; by which bachelors were made incapable of legacies or inheritances by will, unless from their near relations. This brought many to marry, according to Plutarch's observation, not so much

 much for the ſake of raiſing heirs to their own eſtates, as to make themſelves capable of inheriting thoſe of other men.—The rabbins maintain, that, by the laws of Moſes, every body, except ſome few particulars, is obliged in conſcience to marry at 20 years of age: this makes one of their 613 precepts. Hence thoſe maxims ſo frequent among their caſuiſts, that he who does not take the neceſſary meaſures to leave heirs behind him, is not a man, but ought to be reputed a homicide.—Lycurgus was not more favourable: by his laws, bachelors are branded with infamy, excluded from all offices civil and military, and even from the ſhows and public ſports. At certain feaſts they were forced to appear, to be expoſed to the public deriſion, and led round the market-place. At one of their feaſts, the women led them in this condition to the altars, where they obliged them to make *amende honourable* to nature, accompanied with a number of blows and laſhes with a rod at diſcretion. To complete the affront, they forced them to ſing certain ſongs compoſed in their own deriſion.—The Chriſtian religion is more indulgent to the bachelor ſtate: the ancient church recommended it as in ſome circumſtances preferable to, and more perfect than, the matrimonial. In the canon law, we find injunctions on bachelors, when arrived at puberty, either to marry or to turn monks and profeſs chaſtity in earneſt.—In England, there was a tax on bachelors, after 25 years of age, 12 l. 10s. for a duke, a common perſon 1 s. by 7 Wil. III. 1695. In Britain, at preſent, they are taxed by an extra-duty on their ſervants. Every man of the age of 21 years and upwards, never having been married, who ſhall keep one male ſervant or more, ſhall pay 1 l. 5 s. for each above or in addition to the ordinary duties leviable for SERVANTS. Every man of the age of 21 years and upwards, never having been married, keeping one female ſervant, ſhall pay 2 s. 6 d. in addition to the former 2 s. 6 d.; 5 s. in addition for each, if he has two female ſervants; and 10s. in addition for each for three or more female ſervants.

BACHELOR, was anciently a denomination given to thoſe who had attained to knighthood, but had not a number of vaſſals ſufficient to have their banner carried before them in the field of battle; or if they were not of the order of Bannerets, were not of age to diſplay their own banner, but obliged to march to battle under another's banner. It was alſo a title given to young cavaliers, who, having made their firſt campaign, received the military girdle accordingly. And it ſerved to denominate him who had overcome another in a tournament, the firſt time he ever engaged.—The word *bachelor*, in a military ſenſe, is derived by Cujas from *buccellarius*, a kind of cavalry, anciently in great eſteem. Du Cange deduces it from *baccalaria*, a kind of fees or farms, conſiſting of ſeveral pieces of ground, each whereof contained 12 acres or as much as two oxen would plough; the poſſeſſors of which baccalaria were called *bachelors*. Caſeneuve and Altaſerra derive bachelor from *baculus* or *bacillus*, "a ſtaff," becauſe the young cavaliers exerciſed themſelves in fighting with ſtaves. Martinius derives it from *baccalaureus*, i. e. *bacca laurea donatus*, in alluſion to the ancient cuſtom of crowning poets with laurel, *baccis lauri*, as was the caſe with Petrarch at Rome in 1341. Alciat and Vives are of the ſame opinion: nor is this etymology improbable.

Knights-BACHELORS, the moſt ancient, but the loweſt order of knights in England; known by the name of *knights* only. They are ſtyled *knights bachelors*, either (according to ſome) as denoting their degree, *quaſi bas chevaliers*; or, according to others, becauſe this title does not deſcend to their poſterity.

The cuſtom of the ancient Germans was to give their young men a ſhield and a lance in the great council: this was equivalent to the *toga virilis* of the Romans. Before this, they were not permitted to bear arms, but were accounted as part of the father's houſehold; after it, as part of the public. Hence ſome derive the uſage of knighting, which has prevailed all over the weſtern world, ſince its reduction by colonies, from thoſe northern heroes. Knights are called in Latin *equites aurati*: *aurati*, from the gilt ſpurs they wore; and *equites*, becauſe they always ſerved on horſeback: for it is obſervable, that almoſt all nations call their knights by ſome appellation derived from an horſe. They are alſo called in our law *milites*, becauſe they formed a part, or indeed the whole, of the royal army, in virtue of their feodal tenures; one condition of which was, that every one who held a knight's fee (which in Henry II.'s time amounted to 20 l. *per annum*) was obliged to be knighted, and attend the king in his wars, or pay a fine for his non-compliance. The exertion of this prerogative, as an expedient to raiſe money in the reign of Charles I. gave great offence, though warranted by law and the recent example of Queen Elizabeth. At the Reſtoration, it was, together with all other military branches of the feodal law, aboliſhed: and it now only exiſts as an honorary title; though, on account of its indiſcriminate attainment, not very generally regarded. It is conferred indiſcriminately upon gownſmen, burghers, and phyſicians, by the king's lightly touching the perſon, who is then kneeling, on the right ſhoulder with a drawn ſword, and ſaying, *Riſe, Sir*. See the articles KNIGHT and NOBILITY.

BACHELORS, in an univerſity ſenſe, are perſons that have attained to the baccalaureate, or who have taken the firſt degree in the liberal arts and ſciences.

The degree of bachelor was firſt introduced in the 13th century by Pope Gregory IX. but it remains ſtill unknown in Italy. At Oxford, before a perſon is intitled to the degree of *bachelor of arts*, he muſt have ſtudied there four years; three years more to become maſter of arts; and ſeven more to commence bachelor of divinity.—At Cambridge, to commence bachelor of arts, he muſt have been admitted near four years; and above three years more before he commences maſter; and ſeven more ſtill to become bachelor of divinity. He may commence bachelor of law after having ſtudied it ſix years.—At Paris, to paſs bachelor in theology, a perſon muſt have ſtudied two years in philoſophy and three years in theology, and held two acts of examination in the Sorbonne.—Bachelors in the canon law are admitted after two years ſtudy in the ſame, and ſuſtaining an act according to the forms. A bachelor of phyſic muſt have ſtudied two years in medicine after having been four years maſter of arts in the univerſity, and have ſtood an examination; after which he is inveſted with the fur, in order to be licenſed.—In the univerſity of Paris, before the foundation of divinity-profeſſorſhips, thoſe who had ſtudied divinity ſix years were admitted to go through their courſe, whence they were called *baccalarii curſores*; and as there were two courſes, the firſt employed in explaining the Bible during three ſucceſſive years, the ſecond for explaining the maſter of the ſentences for one year, thoſe who were in the Bible-courſe were called *baccalarii Biblici*, and thoſe arrived at the ſentences *baccalarii ſententiarii*. And, laſtly, thoſe who had gone through both were denominated *baccalarii formati*, or *formed bachelors*.

At preſent, *formed bachelor* denotes a perſon who has taken the degree regularly after the due courſe of ſtudy and exerciſes required by the ſtatutes; by way of oppoſition to a *current bachelor*, who is admitted in the way of grace, or by diploma.

We alſo find mention of bachelors of the church, *baccalarii eccleſiæ*. The biſhop with his canons and *baccalarii, cum conſilio et conſenſu omnium canonicorum ſuorum et baccalariorum.*

Bachelors, in the Livery companies of London, are thoſe not yet admitted to the livery. Theſe companies generally conſiſt of a maſter, two wardens, the livery, and the bachelors, who are yet but in expectation of dignity in the company, and have their function only in attendance on the maſter and wardens. They are alſo called *yeomen*.

Bachelor is alſo a name given in the ſix companies of merchants at Paris to the elders, and ſuch as having ſerved the offices, have a right to be called by the maſters and wardens to be preſent with them, and aſſiſt them in ſome of the functions, particularly in what relates to the *chef-d'oeuvres* or maſter-pieces, of ſuch as are candidates for being admitted maſters.

BACHERAC, a town of the Palatine of the Rhine, ſituated on the weſtern ſhore of that river, in E. Long. 7°. and N. Lat. 58°. It is remarkable for excellent wine, from thence called *Bacherac*.

BACHIAN, one of the Molucca iſlands, belonging to the Dutch; ſituated under the Equator, in E. Long. 125°.

BACHU, a city of Shirvan in Perſia, and the beſt haven in the Caſpian ſea. It is defended by a double wall, as alſo by a ditch and redoubts, made by the Ruſſians when they were maſters of the place. It had a ſumptuous caſtle, but it is reduced to a ruinous ſtate by the Ruſſians. Formerly many merchants reſided here, and carried on a conſiderable traffic in raw ſilk; but that commerce is now given up. All the country round is much impregnated with ſulphur, which renders the water very unpleaſant. The neighbourhood of this city ſupplies the countries adjacent with naphtha, brimſtone, and rock-ſalt; and is the only place thereabouts which produces ſaffron. Round Bachu are ſeveral very ſteep craggy mountains, on which are ſtrong watch towers. E. Long. 49. 5. N. Lat. 40. 0

BACK, *Back-Bone*, or Spine. See Anatomy, n° 30.

Back, in the menage, and among farriers. A horſe's back ſhould be ſtraight, not hollow, which is called *ſaddle-backed*: horſes of this kind are generally light, and carry their heads high, but want in ſtrength and ſervice. A horſe with a weak back is apt to ſtumble.

In the French riding-ſchools, to mount a horſe *a dos*, is to mount him bare-backed, without a ſaddle.

Back-Gammon; an ingenious game played with dice, upon a table, by two perſons.

Manner of playing the game. The table is divided into two parts, upon which there are 24 black and white ſpaces, called points. Each adverſary has 15 men, black and white, to diſtinguiſh them; and they are diſpoſed of in the following manner: Suppoſing the game to be played into the right-hand table, two are placed upon the ace point in the adverſary's table, five upon the ſix point in the oppoſite table, three upon the cinque point in the hithermoſt table, and five on the ſix point in the right-hand table. The grand object in this game is for each player to bring the men round into his right-hand table, by throwing with a pair of dice thoſe throws that contribute towards it, and at the ſame time prevent the adverſary doing the like. The firſt beſt throw upon the dice is eſteemed aces, becauſe it ſtops the ſix point in the outer table, and ſecures the cinque in the thrower's table; whereby the adverſary's two men upon the thrower's ace point cannot get out with either quatre, cinque, or ſix. This throw is an advantage often given to the antagoniſt by the ſuperior player.

When he carries his men home in order to loſe no point, he is to carry the moſt diſtant man to his adverſary's bar point, that being the firſt ſtage he is to place it on; the next ſtage is ſix points farther, viz. in the place where the adverſary's five men are firſt placed out of his tables. He muſt go on in this method till all his men are brought home, except two, when by loſing a point, he may often ſave the gammon, by throwing two fours or two fives.

When a hit is only played for, he ſhould endeavour to gain either his own or adverſary's cinque point; and if that fails by his being hit by the adverſary, and he finds him forwarder than himſelf, in that caſe he muſt throw more men into the adverſary's tables; which is done in this manner: He muſt put a man upon his cinque or bar point; and if the adverſary neglects to hit it, he may then gain a forward game inſtead of a back game: but if the adverſary hits him, he ſhould play for a back game; and then the greater number of men which are taken up makes his game the better, becauſe by theſe means he will preſerve his game at home: and then he ſhould endeavour to gain both his adverſary's ace and the trois points, or his ace and deuce points, and take care to keep three men upon the adverſary's ace point, that in caſe he hits him from thence, that point may remain ſtill ſecure to himſelf.

A back game ſhould not be played for at the beginning of a ſet, becauſe it would be a great diſadvantage, the player running the riſk of a gammon to win a ſingle hit.

Rules for playing at ſetting out all the throws on the dice, when the player is to play for a gammon or for a ſingle hit (A). 1. Two aces are to be played on the cinque point and bar point, for a gammon or for a hit. 2. Two ſixes, to be played on the adverſary's bar

(A) The rules marked thus are for a gammon only; thoſe marked thus * are for a hit only.

Backgammon.

bar point and on the thrower's bar point, for a gammon or for a bit. 3. † Two trois, to be played on the cinque point, and the other two on the trois point in his own tables, for a gammon only. 4. † Two deuces, to be played on the quatre point in his own tables, and two to be brought over from the five men placed in the adversary's tables for a gammon only. 5. † Two fours, to be brought over from the five men place in the adversary's tables, and to be put upon the cinque point in his own tables for a gammon only. 6. Two fives, to be brought over from the five men placed in the adversary's tables, and to be put on the trois point in his own tables, for a gammon or for a hit. 7. Size ace, he must take his bar point for a gammon or for a hit. 8. Size deuce, a man to be brought from the five men placed in the adversary's tables, and to be placed in the cinque point in his own tables, for a gammon or for a hit. 9. Six and three, a man to be brought from the adversary's ace point, as far as he will go, for a gammon or for a hit. 10. Six and four, a man to be brought from the adversary's ace point, as far as he will go, for a gammon or for a hit. 11. Six and five, a man to be carried from the adversary's ace point, as far as he can go, for a gammon or for a hit. 12. Cinque and quatre, a man to be carried from the adversary's ace point, as far as he can go, for a gammon or for a hit. 13. Cinque trois to make the trois point in his table, for a gammon or for a hit. 14. Cinque deuce, to play two men from the five placed in the adversary's tables, for a gammon or for a hit. 15. † Cinque ace, to bring one man from the five placed in the adversary's tables for the cinque, and to play one man down on the cinque point in his own tables for the ace, for a gammon only. 16. Quatre trois, two men to be brought from the five place in the adversary's tables, for a gammon or for a hit. 17. Quatre deuce, to make the quatre point in his own tables, for a gammon or for a hit. 18. † Quatre ace, to play a man from the five placed in the adversary's tables for the quatre; and for the ace, to play a man down upon the cinque point in his own tables, for a gammon only. 19. † Trois deuce, two men to be brought from the five placed in the adversary's tables, for a gammon only. 20. Trois ace, to make the cinque point in his own tables, for a gammon or for a hit. 21. † Deuce ace, to play one man from the five men placed in the adversary's table for the deuce; and for the ace to play a man down upon the cinque point in his own tables, for a gammon only. 22. * Two trois, two of them to be played on the cinque point in his own tables, and with the other two he is to take the quatre point in the adversary's tables. 23. * Two deuces, two of them are to be played on the quatre point in his own tables, and with the other two he is to take the trois point in the adversary's tables. By playing these two cases in this manner, the player avoids being shut up in the adversary's tables, and has the chance of throwing out the tables to win the hit.

24. * Two fours, two of them are to take the adversary's cinque point in the adversary's tables, and for the other two, two men are to be brought from the five placed in the adversary's tables. 25. * Cinque ace, the cinque should be played from the five men placed in the adversary's tables, and the ace from the adversary's ace point. 26. * Quatre ace, the quatre to be played from the five men placed in the adversary's ace point. 27. * Deuce ace, the deuce to be played from the five men placed in the adversary's tables, and the ace from the adversary's ace point.

The three last chances are played in this manner; because an ace laid down in the adversary's tables, there is a probability of throwing deuce ace, trois deuce, quatre trois, or size cinque, in two or three throws; either of which throws secures a point, and gives the player the best of the hit.

Cautions, &c. The player must understand by the directions given to play for a gammon, that he is to make some blots on purpose, the odds being in his favour that they are not hit; but if it should happen that any blot is hit, as in this case there will be three men in the adversary's tables, he must then endeavour to secure the adversary's cinque, quatre, or trois point, to prevent a gammon, and must be very cautious of his fourth man's not being taken up.

He must not crowd his game at any time if he can help it; that is to say, he should not put many men either upon the trois or deuce points in his own tables, being the same as losing those men not having them in play. Besides, by crowding the game, and attempting to save a gammon, the player is often gammoned. His game being crowded in his own tables, the adversary has room to play as he thinks proper.

The following calculations will show the odds of entering a single man upon any certain number of points; and accordingly the game should be played.

It is necessary to know that there are thirty-six chances upon two dice, and the points that are upon these thirty-six chances are as follow.

Viz.	Points.
2 Aces - -	4
2 Deuces - -	8
2 Trois - -	12
2 Fours - -	16
2 Fives - -	20
2 Sixes - -	24
6 And 5 twice -	22
6 And 4 twice -	20
6 And 3 twice -	18
6 And 2 twice -	16
6 And 1 twice -	14
5 And 4 twice -	18
5 And 3 twice -	16
5 And 2 twice -	14
5 And 1 twice -	12
4 And 3 twice -	14
4 And 2 twice -	12
4 And 1 twice -	10
3 And 2 twice -	10
3 And 1 twice -	8
2 And 1 twice -	6

Divide by 36)294(8

and it proves, that upon an average the player has a right to 8 points each throw. 288

6

The

Back-gammon.

The chances upon two dice calculated for back-gammon are as follow.

	2 Sixes	1
	2 Fives	1
	2 Fours	1
	2 Trois	1
	2 Deuces	1
†	2 Aces	1
	6 And 5 twice	2
	6 And 4 twice	2
	6 And 3 twice	2
	6 And 2 twice	2
†	6 And 1 twice	2
	5 And 4 twice	2
	5 And 3 twice	2
	5 And 2 twice	2
†	5 And 1 twice	2
	4 And 3 twice	2
	4 And 2 twice	2
†	4 And 1 twice	2
	3 And 2 twice	2
†	3 And 1 twice	2
†	2 And 1 twice	2
		36

As it may seem difficult to find out by this table of thirty-six chances what are the odds of being hit upon a certain or flat die, let the following method be pursued.

The player may observe in the table that what are thus † marked are,

† 2 Aces	1
† 6 And 1 twice	2
† 5 And 1 twice	2
† 4 And 1 twice	2
† 3 And 1 twice	2
† 2 And 1 twice	2
Total	11
Which deducted from	36
There remain	25

So that it appears it is twenty-five to eleven against hitting an ace upon a certain or flat die.

The above method holds good with respect to any other flat die. For example, what are the odds of entering a man upon 1, 2, 3, 4, or 5 points?

Answer.

To enter it upon	for	against		for	ag.
1 point is	11 to	25	Or about	4 to	9
2 points	20	16		5	4
3	27	9		3	1
4	32	4		8	1
5	35	1		35	1

The following table shows the odds of hitting with any chance, in the reach of a single die.

To hit upon	for	against		for	ag.
1 is	11 to	25	Or about	4 to	9
2	12	24		1	2
3	14	22		2	3
4	15	21		5	7
5	15	21		5	7
6	17	19		$8\frac{1}{2}$	$9\frac{1}{2}$

The odds of hitting with double dice are as follow.

To hit upon	for	against		for	ag.
7 is	6 to	30	Or about	1 to	5
8	6	30		1	5
9	5	31		1	6
10	3	33		1	11
11	2	34		1	17
12	1	36		1	35

How to find out the odds of being hit upon a six, by the tables of thirty-six chances.

2 Sixes	1
2 Trois	1
2 Deuces	1
6 And 5 twice	2
6 And 4 twice	2
6 And 3 twice	2
6 And 2 twice	2
6 And 1 twice	2
5 And 1 twice	2
4 And 2 twice	2
	17
Which deducted from	36
There remains	19

By which it appears to be 19 to 17 against being hit upon a six.

The odds on the hits.

2 Love is about	5 to	2
2 to 1 is	2	1
1 Love is	3	2

Directions for the player to bear his men. If a player has taken up two of the adversary's men, and happens to have two, three, or more points made in his own tables, he should spread his men, that he either may take a new point in his tables, or be ready to hit the man which the adversary may happen to enter. If he finds upon the adversary's entering, that the game is upon a par, or that the advantage is on his own side, he should take the adversary's man up whenever he can, it being 25 to 11 that he is not hit: except when he is playing for a single hit only; then, if playing the throw otherwise gives him a better chance for it, he ought to do it.

It being five to one against his being hit with double dice, he should never be deterred from taking up any one man of the adversary's.

If he has taken up one of the adversary's men, and should happen to have five points in his own tables, and forced to leave a blot out of his tables, he should endeavour to leave it upon doublets preferable to any other chance, because in that case the odds are 35 to one that he is not hit; whereas it is only 17 to one but he is hit upon any other chance.

When the adversary is very forward, a player should never move a man from his own quatre, trois, or deuce points, thinking to bear that man from the point where he put it, as nothing but high doublets can give him any chance for the hit. Instead of playing an ace or a deuce from any of those points, he should play them from his own size or highest points, so that throwing two fives, or two fours, his size and cinque-points being eased, would be a considerable advantage to him; whereas

Back-gammon.

whereas had they been loaded, he must have been obliged to play otherwise.

It is the interest of the adversary to take up the player as soon as he enters. The blot should be left upon the adversary's lowest point; that is to say, upon his deuce point, rather than upon his trois point; or upon his trois point rather than his quatre point; or upon his quatre point preferable to his cinque point, for a reason before mentioned; all the men the adversary plays upon his trois, or his deuce points, are deemed lost, being greatly out of play; so that those men not having it in their power to make his cinque point, and his game being crowded in one place and open in another, the adversary must be greatly annoyed by the player.

If the player has two of the adversary's men in his tables, he has a better chance for a hit than if he had more, provided his game is forwarder than that of his antagonist's; for if he had three or more of the adversary's men in his tables, he would stand a worse chance to be hit.

When a player is running to save the gammon, if he should have two men upon his ace point, and several men abroad, although he should lose one point or two in putting his men into his tables, it is his interest to leave a man upon the adversary's ace point, because it will prevent his adversary from bearing his men to the greatest advantage, and at the same time the player will have a chance of his adversary's making a blot, which he may chance to hit. However, if a player finds upon a throw, that he has a probability of saving his gammon, he should never wait for a blot, as the odds are greatly against his hitting it, but should embrace that opportunity.

How to calculate the odds of saving or winning the gammon. Suppose the adversary has so many men abroad as require three throws to put them into his tables, and at the same time that the player's tables are made up, and that he has taken up one of the adversary's men; in this case, it is about an equal wager that the adversary is gammoned. For in all probability the player has bore two men before he opens his tables, and when he bears the third man, he will be obliged to open his size or cinque point. It is then probable, that the adversary is obliged to throw twice before he enters his men in the player's tables, twice more before he puts that man into his own tables, and three throws more to put the men which are abroad into his own tables, in all seven throws. Now the player having 12 men to bear, he may be forced to make an ace or a deuce twice before he can bear all his men, and consequently will require seven throws in bearing them; so that, upon the whole, it is about equal whether the adversary is gammoned or not.

Suppose a player has three men upon his adversary's ace point and five points in his own tables, and that the adversary has all his men in his tables, three upon each of his five highest points, Has the player a probability of gammoning his adversary or not?

	Points.
For bearing three men from his 6th point is	18
From his 5th point	15
	33
Carried forward	33
From his 4th point	12
From his 3d point	9
From his 2d point	6
In all	60
Bringing his three men from the adversary's ace point to his size point in his own tables, being 18 points each, and making together.	54
There must remain	6

It is plain from this calculation, that the player has much the best of the probability of the gammon, exclusive of one or more blots which the adversary is liable to make in bearing his men, supposing at the same time the throws to be upon an equality.

Suppose two blots are left, either of which cannot be hit but by double dice; one must be hit by throwing eight and the other by throwing nine; so that the adversary has only one die to hit either of them. What are the odds of hitting either of them? The chances of two dice being in all 36

The chances to hit 8 are 6 and 2 twice	2
5 and 3 twice	2
2 Deuces	1
2 Fours	1
The chances to hit 9 are 6 and 3 twice	2
5 And 4 twice	2
2 Trois	1
For hitting, in all	11
Chances for not hitting, remain	25

So that the odds are 25 to 11 against hitting either of these blots.

This method may be taken to find out the odds of hitting three, four, or five blots upon double dice; or blots made upon double and single dice at the same time. After knowing how many chances there are to hit any of those blots, they must be added all together, and then subtract from the number 36, which are the chances of the two dice, and the question is solved.

A critical case for a Back-game. Suppose the foregame to be played by A, and that all his men are placed as usual; B has fourteen of his men placed upon his adversary's ace point, and one upon his adversary's deuce point, and B is to throw. Who has the best of the hit?—*Answer:* A has the best of it, gold to silver: because, if B does not throw an ace to take his adversary's deuce point, which is 25 to 11 against him, A will take up B's men in his tables, either singly or to make points; and then if B secures either A's deuce or trois point, A will put as many men down as possible, in order to hit, and thereby get a back-game. It is evident that the back-game is very powerful; consequently, whoever practises it must become a greater proficient at the game than he could by any other means.

Another critical case. Suppose A to have five men placed upon his size point, as many upon his quatre point, and the same number upon his deuce point, all in his own tables. At the same time, let us suppose B to have three men placed upon A's ace point, as many upon A's trois point, and the same number upon

upon A's cinque point, in his own tables, and three men placed as usual out of his tables. Who has the best of the hit?—*Answer:* The game is equal, till B has gained his cinque and quatre points in his own tables; which if he can effect, and by playing two men from A's cinque point, in order to force his adversary to blot by throwing an ace, which should B hit, he will have the best of the hit.

A case of curiosity and instruction; in which is shewn the probability of making the hit last by one of the players for many hours, although they should both play as fast as usual.—Suppose B to have bore 13 men, and that A has his fifteen men in B's tables, *viz.* three men upon his size point, as many upon his cinque point, three upon his quatre point, the same number upon his trois point, two upon his deuce point, and one upon his ace point. A in this situation can prolong it, as aforesaid, by bringing his 15 men home, always securing six close points till B has entered his two men, and brought them upon any certain point; as soon as B has gained that point, A will open an ace, deuce, or trois point, or all of them; which done B hits one of them, and A taking care to have two or three men in B's tables, is ready to hit that man; and also he being certain of taking up the other man, has it in his power to prolong the hit almost to any length, provided he takes care not to open such points as two fours, two fives, or two sixes, but always to open the ace, deuce, or trois points, for B to hit him.

A critical game to play. Suppose A and B place their men for a hit in the following manner: A to have three men upon the size point in his own tables, three men out of his tables upon the usual point, and nine men upon his adversary's ace, deuce, and trois points; that is, three upon each; and suppose B's men to be placed in his own and his adversary's tables in the same order. So situated, the best player should win the hit. The game being so equal, that in this case the dice should be thrown for. Now if A throws first, he should endeavour to gain his adversary's cinque point: this being done, he should lay as many blots as possible, to tempt B to hit him, as it puts him backward, and A thereby gains an advantage. A should always endeavour to have three men upon each of his adversary's ace and deuce points; because when B makes a blot, these points will remain secure, and when A has bore five, six, or more men, A yet may secure six close points out of his tables, in order to prevent B from getting his man home, at which time he should calculate who has the best of the hit. If he finds that B is foremost, he should then try to lay such blots as may be taken up by his adversary, that he may have a chance of taking up another man, in case B should happen to have a blot at home.

Laws of Backgammon. 1. If a man is taken from any point, it must be played; if two men are taken from it, they also must be played. 2. A man is not supposed to be played till it is placed upon a point and quitted. 3. If a player has only fourteen men in play, there is no penalty inflicted, because by his playing with a lesser number than he is intitled to, he plays to a disadvantage for want of the deficient man to make up his tables. 4. If he bears any number of men before he has entered a man taken up, and which of course he was obliged to enter, such men so borne must be entered again in the adversary's tables as well as the man taken up. 5. If he has mistaken his throw and played it, and his adversary has thrown, it is not in the choice of either of the players to alter it, unless they both agree so to do.

Back-Painting, the method of painting mezzotinto prints, pasted on glass, with oil-colours. See Mezzotinto.

The art consists chiefly in laying the print upon a piece of crown-glass, of such a size as fits the print.

In order to do this, take your print, and lay it in clean water for two days and two nights, if the print be on very strong, close, and hard gummed paper; but if upon an open, soft, spungy paper, two hours will sometimes suffice, or more, according as the paper is.

The paper or picture having been sufficiently soaked, take it out and lay it upon two sheets of paper, and cover it with two more; and let it lie there a little to suck out the moisture.

In the mean time, take the glass the picture is to be put upon, and set it near the fire to warm; take Strasburg turpentine, warm it over the fire till it is grown fluid, then with a hog's-hair brush spread the turpentine very smoothly and evenly on the glass.

When this has been done, take the mezzotinto print from between the papers, and lay it upon the glass; beginning first at one end, rubbing it down gently as you go on, till it lie close, and there be no wind bladders between.

Then, with your fingers, rub or roll off the paper from the back side of the print, till it looks black, *i. e.* till you can see nothing but the print, like a thin film, left upon the glass, and set it by to dry.

When it is dry, varnish it over with some white transparent varnish, that the print may be seen through it; and then it is fit for painting.

The utmost care will be necessary in rubbing or rolling the paper of the print, so as not to tear it, especially in the light parts.

You may, instead of soaking your prints two days and two nights, roll them up and boil them for about two hours, more or less, according to the quality of the paper, in water; and that will render it as fit for rubbing, rolling, or peeling, as the other way.

This being done, and your oil-colours prepared, ground very fine, and tempered very stiff, lay on the back-side of the transparent prints such colours as each particular part requires; letting the master-lines of the print still guide your pencil, and so each particular colour will lie fair to the eye on the other side of the glass, and look almost as well as a painted piece, if it be done neatly.

The shadows of the print are generally sufficient for the shadow of every colour; but if you have a mind to give a shadow by your pencil, then let the shadows be laid on first, and the other colours afterward.

In laying on colours in this kind of back-painting, you need not be curious as to the laying them on smooth. This is not at all requisite here, where the chief aim is only to have the colours appear well on the fore side of the print; and therefore the only care to be used in this work, is to lay the colours on thick enough, that its body may strike the colour of it plainly through the glass.

Back-Staff, a name formerly given to a sea-quadrant

drant invented by Captain Davis: because the back of the artist is turned towards the sun at the time of observation. See QUADRANT.

BACK-Stays, of a ship, are ropes belonging to the main-mast and fore-mast, and the masts belonging to them; serving to keep them from pitching forwards or overboard.

BACK-Tack, in Scots law: When a wadsetter, instead of possessing the wadset-lands, grants a tack thereof to the reverser for payment of a certain sum in name of tack-duty, that tack is called a *back-tack*.

BACK-Worm. See FILANDERS.

BACKER, or BAKKER, (Jaques), a painter of history, was born at Antwerp in 1530; and learned the principles of painting from his father, who was an artist very knowing in his profession, though his works were in no great estimation. After the death of his father, he lived in the house of Jacopo Palermo, a dealer in pictures, who avariciously took care to keep him incessantly employed, and sent his paintings to Paris to be disposed of, where they happened to be exceedingly admired. The judicious were very eager to purchase them; and though the transactor sold them at a great price, yet the poor artist was not proportionably rewarded, but continued in the same obscure and depressed condition. His merit, indeed, was universally allowed, but his name, and the narrowness of his circumstances, were as universally unknown. He had a clean light manner of pencilling, and a tint of colour that was extremely agreeable.—He died in 1560.

BACKER, or BAKKER, (Jacob), painter of portrait and history, was born at Harlingen in 1609, but spent the greatest part of his life at Amsterdam; and by all the writers on this subject, he is mentioned as an extraordinary painter, particularly of portraits, which he executed with strength, spirit, and a graceful resemblance. He was remarkable for an uncommon readiness of hand and freedom of pencil; and his incredible expedition in his manner of painting, appeared even in one portrait of a lady from Haerlem, that he painted at half length, which was begun and finished in one day, though he adorned the figure with rich drapery and several ornamental jewels. He also painted historical subjects with good success; and in that style there is a fine picture of Cimon and Iphigenia, which is accounted by the connoisseurs an excellent performance. In designing academy figures his expression was so just, and his outline so correct, that he obtained the prize from all his competitors; and his works are still bought up at very high prices in the Low Countries. In the collection of the Elector Palatine there is an excellent head of Brouwer, painted by this master; and in the Carmelites church at Antwerp is preserved a capital picture of the Last Judgment, which is well designed and well coloured. He died in 1651.

BACKEREEL, called BACQUERELLI, (William) a painter of history, was born at Antwerp, and was a disciple of Rubens, at the same time that Vandyck was educated in that school. When each of them quitted that master and commenced painters, Backereel was very little inferior to Vandyck, if not nearly his equal. And this may be manifestly seen in the works of the former, which are in the church of the Augustin Monks at Antwerp; where those two great artists painted in competition, and both were praised for their merit in their different ways; but the superiority was never determined in favour either of the one or the other. He had likewise a good taste for poetry; but, by exercising that talent too freely, in writing satires against the Jesuits, these ecclesiastics pursued him with unremitted revenge, till they compelled him to fly from Antwerp; and by that means deprived his own country of such paintings as would have contributed to its perpetual honour.—Sandrart took notice, that in his time there were seven or eight painters, who were very eminent, of the name of Backereel, in Italy and the Low Countries.

BACKHUYSEN (Ludolph), an eminent painter, was born at Embden in 1631, and received his earliest instruction from Albert Van Everdingen; but acquired his principal knowledge by frequenting the painting rooms of different great masters, and observing their various methods of touching and colouring. One of those masters was Henry Dubbels, whose understanding in his art was very extensive; and he was as remarkably communicative of his knowledge to others. From him Backhuysen obtained more real benefit than from all the painters of his time, either by studying their works, or personally conversing with them. His subjects were sea-pieces, ships, and sea-ports. He had not practised very long when he became the object of general admiration; so that even his drawings were sought after, and several of them were bought up at 100 florins a-piece. It was observed of him, that while he was painting, he would not suffer even his most intimate friends to have access to him, lest his fancy might be disturbed, and the ideas he had formed in his mind be interrupted. He studied nature attentively in all her forms; in gales, calms, storms, clouds, rocks, skies, lights, and shadows; and he expressed every subject with so sweet a pencil, and such transparence and lustre, as placed him above all the artists of his time in that style, except the younger Vandervelde, who is deservedly esteemed the first in that manner of painting. It was a frequent custom with Backhuysen, whenever he could procure resolute mariners, to go to sea in a storm, in order to store his mind with grand images, directly copied from nature, of such scenes as would have filled any other head and heart with terror and dismay; and the moment he landed, he always impatiently ran to his palette to secure these incidents, of which the traces might by delay be obliterated.—He perfectly understood the management of the Chiaro-Scuro, and by his skill in that part of his art, he gave uncommon force and beauty to his objects. He observed strictly the truth of perspective, in the distances of his vessels, the receding of the grounds on the shores, and the different buildings which he described in the sea-ports; whether they were the result of his own imagination, or sketched, as he usually did, after nature. His works may easily be distinguished by an observant eye, from the freedom and neatness of his touch; from the clearness, and natural agitation or quiescence of the water; from a peculiar tint in his clouds and skies; and also from the exact proportions of his ships, and the gracefulness of their position. For the Burgomasters of Amsterdam he painted a large picture, with a multitude of vessels, and a view of the

city

city at a distance, for which they gave him thirteen hundred guilders, and a considerable present; which picture they afterwards presented to the king of France, who placed it in the Louvre. No painter was ever more honoured by the visits of the kings and princes than Backhuysen; the king of Prussia was one of the number; and the Czar Peter the Great took delight to see him paint, and often endeavoured to draw after vessels which he had designed. He was remarkably assiduous, and yet it seems astonishing to consider the number of pictures which he finished, and the exquisite manner in which they are painted. He died in 1709.

BACKING, in horsemanship. See HORSEMANSHIP.

BACKING *the Sails*, in navigation; to arrange them in a situation that will force the ship to retreat, or move backwards. This is, however, only done in narrow channels, when a ship is carried along sidewise by the tide or current, and wants to avoid any thing that may interrupt her progress, as shoals, vessels at anchor, &c. or in the line of battle, when a ship wants to be immediately opposite to another with which she is engaged.

BACKS, among dealers in leather, denote the thickest and best tanned hides, used chiefly for soles of shoes.

BACKS, in brewing and distilling. See BAC.

BACULARIUS, in writers of the middle age, an ecclesiastical apparitor, or verger; who carries a staff, *baculus*, in his hand, as an ensign of his office.

BACON, swines flesh salted, and dried in the chimney.—Old historians and law-writers speak of the *service of the bacon*, a custom in the manor of Whichenacre in Staffordshire, and priory of Dunmore in Essex; in the former of which places, by an ancient grant of the lord, a flitch of bacon, with half a quarter of wheat, was to be given to every married couple who could swear, that, having been married a year and a day, they would never within that time have once exchanged their mate for any other person on earth, however richer, fairer, or the like. But they were to bring two of their neighbours to swear with them that they believed they swore the truth. On this the lord of another neighbouring manor, of Rudlow, was to find a horse saddled, and a sack to carry the bounty in, with drums and trumpets, as far as a day's journey out of the manor: all the tenants of the manor being summoned to attend, and pay service to the bacon. The bacon of Dunmore, first erected under Henry III. was on much the same footing; only the tenor of the oath was, that the parties had never once repented, or wished themselves unmarried again.

BACON (Roger), a Franciscan friar of amazing genius and learning, was born near Ilchester in Somersetshire, in the year 1214. He began his studies at Oxford; but in what school, or college is uncertain. Thence he removed to the university of Paris, which, in those times, was esteemed the centre of literature. Here, we are told, he made so rapid a progress in the sciences, that he was esteemed the glory of that university, and was much caressed by several of his countrymen, particularly by Robert Grouthead, afterwards bishop of Lincoln, his singular friend and patron. About the year 1240, he returned to Oxford; and assuming the Franciscan habit, prosecuted his favourite study of experimental philosophy, with unremitting ardor and assiduity. In this pursuit, in experiments, instruments, and in scarce books, he tells us, he spent, in the space of 20 years, no less than L. 2000; which it seems, was given him by some of the heads of the university, to enable him to prosecute his noble inquiries. By such extraordinary talents, and astonishing progress in sciences, which, in that ignorant age, were totally unknown to the rest of mankind, whilst they raised the admiration of the more intelligent few, could not fail to excite the envy and malice of his illiterate fraternity; who found no difficulty of possessing the vulgar with the notion of Bacon's dealing with the devil. Under this pretence, he was restrained from reading lectures; his writings were confined to his convent; and finally, in 1278, he himself was imprisoned in his cell. At this time he was 64 years of age. Nevertheless, being permitted the use of his books, he went on in the rational pursuit of knowledge, corrected his former labours, and wrote several curious pieces. When he had been 10 years in confinement, Jerom de Ascoli being elected pope, Bacon solicited his holiness to be released; in which, it seems, he did not immediately succeed. However, towards the latter end of that pope's reign, he obtained his liberty, and spent the remainder of his life in the college of his order, where he died in the year 1294, in the 80th year of his age, and was buried in the Franciscan church. Such are the few particulars which the most diligent researches have been able to discover concerning this very great man; who, like a single bright star in a dark hemisphere, shone forth the glory of his country, and the pride of human nature. His works are, 1. *Epistola fratris Rogeri Baconis de secretis operibus artis et naturæ, et de nullitate magiæ*. Paris, 1542, 4to. Basil, 1593, 8vo. 2. *Opus majus*. Lond. 1733, fol. published by Dr Jebb. 3. *Thesaurus chemicus*. Francf. 1603, 1620. This was probably the editor's title; but it contains several of our author's treatises on this subject. These printed works of Bacon contain a considerable number of essays, which, in the catalogue of his writings by Bale, Pits, &c. have been considered as distinct books; but there remain in different libraries several manuscripts not yet published. By an attentive perusal of his works, the reader will be astonished to find, that this great luminary of the 13th century was a great linguist and a skilful grammarian; that he was well versed in the theory and practice of perspective; that he understood the use of convex and concave glasses, and the art of making them; that the *camera obscura*, burning-glasses, and the power of the telescope, were known to him; that he was well versed in geography and astronomy; that he knew the great error in the kalendar, assigned the cause, and proposed the remedy; that he understood chronology well; that he was an adept in chemistry, and was really the inventor of gun-powder; that he possessed great knowledge in the medical art; that he was an able mathematician, logician, metaphysician, and theologist.

BACON (Sir Nicholas), lord keeper of the great seal in the reign of Queen Elizabeth, was born at Chislehurst, in Kent, in 1510, and educated at the university of Cambridge; after which he travelled into France, and made some stay at Paris. On his return, he settled in Gray's-inn, and applied himself with such assiduity to the study of the law, that he quickly distinguished him-

himſelf ſo, that on the diſſolution of the monaſtery of St Edmund's Bury, in Suffolk, he had a grant from King Henry VIII. in the 36th year of his reign, of ſeveral manors. In the 38th of the ſame king, he was promoted to the office of attorney in the court of Wards, which was a place both of honour and profit. In this office he was continued by King Edward VI.; and in 1552 he was elected treaſurer of Gray's-inn. His great moderation and conſummate prudence preſerved him through the dangerous reign of Queen Mary. In the very dawn of that of Elizabeth he was knighted; and on the 22d of December 1558, the great ſeal of England, being taken from Nicholas Heath archbiſhop of York, was delivered to him with the title of *lord keeper*, and he was alſo made one of the Queen's privy council. He had a conſiderable ſhare in the ſettling of religion: as a ſtateſman, he was remarkable for a clear head and deep counſels: but his great parts and high preferment were far from raiſing him in his own opinion, as appears from the modeſt anſwer he gave Queen Elizabeth, when ſhe told him his houſe at Redgrave was too little for him: "Not ſo, madam, (returned he); but your majeſty has made me too great for my houſe." After having had the great ſeal more than 20 years, this able ſtateſman and faithful counſellor was ſuddenly removed from this life, as Mr Mallet informs us, by the following accident: he was under the hands of the barber, and thinking the weather warm, had ordered a window before him to be thrown open, but fell aſleep as the current of freſh air was blowing in upon him, and awakened ſome time after diſtempered all over. He was immediately removed into his bed-chamber, where he died a few days after, on the 26th of February 1578-9, equally lamented by the Queen and her ſubjects. He was buried in St Paul's, where a monument was erected to him, which was deſtroyed by the fire in London in 1666. Mr Granger obſerves, that he was the firſt lord keeper that ranked as lord chancellor; and that he had much of that penetrating genius, ſolidity, and judgment, perſuaſive eloquence, and comprehenſive knowledge of law and equity, which afterwards ſhone forth with ſo great a luſtre in his ſon, who was as much inferior to his father in point of prudence and integrity as his father was to him in literary accompliſhments.

Bacon (Francis), lord high chancellor of England under king James I. was ſon of Sir Nicholas Bacon lord keeper of the great ſeal in the reign of Queen Elizabeth, by Anne daughter of Sir Anthony Cook, eminent for her ſkill in the Latin and Greek tongues. He was born in 1560; and ſhowed ſuch marks of genius, that he was particularly taken notice of by Queen Elizabeth when very young. He was educated at Trinity-college, Cambridge; and made ſuch incredible progreſs in his ſtudies, that, before he was 16, he had not only run through the whole circle of the liberal arts as they were then taught, but began to perceive thoſe imperfections in the reigning philoſophy, which he afterwards ſo effectually expoſed, and thereby not only overturned that tyranny which prevented the progreſs of true knowledge, but laid the foundation of that free and uſeful philoſophy which has ſince opened a way to ſo many glorious diſcoveries. On his leaving the univerſity, his father ſent him to France; where, before he was 19 years of age, he wrote a general view of the ſtate of Europe; but Sir Nicholas dying, he was obliged ſuddenly to return to England; when he applied himſelf to the ſtudy of the common law, at Gray's-inn. At this period the famous Earl of Eſſex, who could diſtinguiſh merit, and who paſſionately loved it, entered into an intimate friendſhip with him; zealouſly attempted, though without ſucceſs, to procure him the office of queen's ſolicitor; and, in order to comfort his friend under the diſappointment, conferred on him a preſent of land to the value of 1800l. Bacon, notwithſtanding the friendſhip of ſo great a perſon; notwithſtanding the number and power of his own relations; and, above all, notwithſtanding the early prepoſſeſſion of her majeſty in his favour; met with many obſtacles to his preferment during her reign. In particular, his enemies repreſented him as a ſpeculative man, whoſe head was filled with philoſophical notions, and therefore more likely to perplex than forward public buſineſs. It was not without great difficulty that lord treaſurer Burleigh obtained for him the reverſion of regiſter to the ſtar-chamber, worth about 1600 l. a-year, which place fell to him about 20 years after. Neither did he obtain any other preferment all this reign; though if obedience to a ſovereign in what muſt be the moſt diſagreeable of all offices, viz. the caſting reflections on a deceaſed friend, intitled him, he might have claimed it. The people were ſo clamorous even againſt the Queen herſelf on the death of Eſſex, that it was thought neceſſary to vindicate the conduct of the adminiſtration. This was aſſigned to Bacon, which brought on him univerſal cenſure, nay his very life was threatened. Upon the acceſſion of King James, he was ſoon raiſed to conſiderable honours; and wrote in favour of the union of the two kingdoms of Scotland and England, which the King ſo paſſionately deſired. In 1616, he was ſworn of the privy-council. He then applied himſelf to the reducing and recompoſing the laws of England. He diſtinguiſhed himſelf, when attorney-general, by his endeavours to reſtrain the cuſtom of duels, then very frequent. In 1617, he was appointed lord keeper of the great ſeal. In 1618, he was made lord chancellor of England, and created Lord Verulam. In the midſt of theſe honours and applauſes, and multiplicity of buſineſs, he forgot not his philoſophy, but in 1620 publiſhed his great work intitled *Novum Organum*. We find by ſeveral letters of his, that he thought convening of parliaments was the beſt expedient for the king and people. In 1621, he was advanced to the dignity of Viſcount St Albans, and appeared with the greateſt ſplendour at the opening of the ſeſſion of parliament. But he was ſoon after ſurpriſed with a melancholy reverſe of fortune. For, about the 12th of March, a committee of the houſe of commons was appointed to inſpect the abuſes of the courts of juſtice. The firſt thing they fell upon was bribery and corruption, of which the lord chancellor was accuſed. For that very year complaints being made to the houſe of commons of his lordſhip's having received bribes, thoſe complaints were ſent up to the houſe of lords; and new ones being daily made of a like nature, things ſoon grew too high to be got over. The King found it was impoſſible to ſave both his chancellor, who was openly accuſed of corruption, and Buckingham his favourite, who was ſecretly and therefore more dangerouſly attacked as the encourager of whatever

whatever was deemed most illegal and oppressive: he therefore forced the former to abandon his defence, giving him positive advice to submit himself to his peers, and promising upon his princely word to screen him in the last determination, or, if that could not be, to reward him afterwards with ample retribution of favour. The chancellor, though he foresaw his approaching ruin if he did not plead for himself, resolved to obey; and the house of peers, on the 3d of May 1621, gave judgment against him, "That he should be fined 40,000l. and remain prisoner in the tower during the king's pleasure; that he should for ever be incapable of any office, place, or employment, in the state or commonwealth; and that he should never sit in parliament, or come within the verge of the court." The fault which, next to his ingratitude to Essex, thus tarnished the glory of this illustrious man, is said to have principally proceeded from his indulgence to his servants, who made a corrupt use of it. One day, during his trial, passing through a room where several of his domestics were sitting, upon their rising up to salute him, he said, "Sit down, my masters; your rise hath been my fall." *Stephens*, p. 54. And we are told by Rushworth in his historical collections, "That he treasured up nothing for himself or family, but was over-indulgent to his servants, and connived at their takings, and their ways betrayed him to that error; they were profuse and expensive, and had at their command whatever he was master of. The gifts taken were for the most part for interlocutory orders; his decrees were generally made with so much equity, that though gifts rendered him suspected for injustice, yet never any decree made by him was reversed as unjust." It was peculiar to this great man (say the authors of the Biogr. Brit.) to have nothing narrow and selfish in his composition: he gave away without concern whatever he possessed; and believing other men of the same mould, he received with as little consideration. He retired, after a short imprisonment, from the engagements of an active life, to which he had been called much against his genius, to the shade of a contemplative one, which he had always loved. The King remitted his fine, and he was summoned to parliament in the first year of King Charles I. It appears from the works composed during his retirement, that his thoughts were still free, vigorous, and noble. The last five years of his life he devoted wholly to his studies. In his recess he composed the greatest part of his English and Latin works. He expired on the 9th of April, 1626; and was buried in St Michael's church at St Albans, according to the direction of his last will, where a monument of white marble was erected to him by Sir Thomas Meautys formerly his secretary, and afterward clerk of the privy council under two kings. A complete edition of this great man's works was published at London in the year 1740.—Addison has said of him, That he had the sound, distinct, comprehensive knowledge of Aristotle, with all the beautiful light graces and embellishments of Cicero. The honourable Mr Walpole calls him the *Prophet of Arts* which Newton was afterwards to reveal; and adds, that his genius and his works will be universally admired as long as science exists. "As long as ingratitude and adulation are despicable, so long shall we lament the depravity of this great man's heart. Alas! that he who could command immortal fame, should have stooped to the little ambition of power."

Bacon (Sir Nathaniel), knight of the bath, and an excellent painter, was a younger son of the lord keeper, and half brother to the great Sir Francis. He travelled into Italy, and studied painting there; but his manner and colouring approaches nearer to the style of the Flemish school. Mr Walpole observes, that at Culford, where he lived, are preserved some of his works; and at Gorhambury, his father's seat, is a large picture by him in oil, of a cook-maid, with a dead fowl, admirably painted, with great nature, neatness, and lustre of colouring. In the same house is a whole length of him, by himself, drawing on a paper, his sword and pallet hung up, and a half length of his mother by him.

BACONTHORP (John), called the *resolute doctor*, a learned monk, was born towards the end of the 13th century, at Baconthorp a village in Norfolk. He spent the early part of his life in the convent of Blackney, near Walsingham in the same county; whence he removed to Oxford, and from thence to Paris; where being distinguished for his learning, he obtained degrees in divinity and laws, and was esteemed the principal of Averroists*. In 1329 he returned to England, and was immediately chosen twelfth provincial of the English Carmelites. In 1333 he was sent for to Rome; where, we are told, he first maintained the pope's sovereign authority in cases of divorce, but that he afterwards retracted his opinion. He died in London in the year 1346. Leland, Bale, and Pits, unanimously give him the character of a monk of genius and learning. He wrote, 1. *Commentaria seu quæstiones super quatuor libros sententiarum*; and, 2. *Compendium legis Christi, et quodlibeta*: both which underwent several editions at Paris, Milan, and Cremona. Leland, Bale, and Pits, mention a number of his works never published.

* See *Averroes*.

BACTRIA, or Bactriana, now *Chorassan* or *Khorasan*, an ancient kingdom of Asia, bounded on the west by Margiana, on the north by the river Oxus, on the south by mount Paropismus, and on the east by the Asiatic Scythia and the country of the Massagetæ. It was a large, fruitful, and well-peopled country, containing according to Ammianus Marcellinus 1000 cities, though of these only a few are particularly mentioned by historians, of which that formerly called *Maracanda*, now *Samarcand*, is the most considerable.

Of the history of this country we know but little. Authors agree that it was subdued first by the Assyrians, afterwards by Cyrus, and then by Alexander the Great. Afterwards it remained subject to Seleucus Nicator and his successors till the time of Antiochus Theos; when Theodotus, from governor of that province, became king, and strengthened himself so effectually in his kingdom, while Antiochus was engaged in a war with Ptolemy Philadelphus king of Egypt, that he could never afterwards dispossess him of his acquisitions. His posterity continued to enjoy the kingdom for some time, till they were driven out by the Scythians, who reigned in Bactria at the time of Adrian, Antoninus Pius, &c. The Scythians were in their turn driven out by the Huns or Turks, and these often conquered by the Saracens and Tartars; nevertheless

theless they continued in possession of this country in the time of Ladislaus IV. king of Hungary.

In early times the Bactrians differed little in their manners from the Nomades; and being near neighbours of the Scythians, who were a very warlike people, the Bactrian soldiers were reckoned the best in the world. Their appearance was very savage; being of an enormous stature, having a terrible aspect, rough beards, and long hair hanging down their shoulders. Some authors assert that they kept dogs on purpose to devour such as arrived at extreme old age, or who were exhausted by long sickness. They add, that for all their fierceness, the Bactrian husbands were such dupes to their wives, that they durst not complain of them even for conjugal infidelity, to which it seems the latter were very much addicted.

BACTROPERATA, an ancient appellation given to philosophers by way of contempt, denoting a man with a staff and a budget.

We suppose it is of the same people that Pauchasias Radbertus speaks under the corrupt name of *Baccoperitæ*, or *Bacchionitæ*, whom he describes as philosophers who had so great a contempt for all earthly things, that they kept nothing but a dish to drink out of; and that one of this order seeing a peasant scooping up the water in his hand, threw away the cup as a superfluity: which is nothing but the old story of Diogenes the cynic.

BACULE, in fortification, a kind of portcullis, or gate, made like a pit-fall with a counterpoise, and supported by two great stakes. It is usually made before the corpade-guard, not far from the gate of a place.

BACULOMETRY, the art of measuring accessible or inaccessible heights, by the help of one or more baculi, staves, or rods. See GEOMETRY.

BACURIUS, or BATURIUS, king of the Iberians, a people on the side of the Caspian sea. One day being a hunting, he lost sight of his company, through a great storm and sudden darkness; upon which he vowed to the God of his Christian slave, that if he were delivered he would worship him alone: the day breaking up immediately, he made good his promise, and became the apostle of his country.

BADAGSHAN, a very ancient city of Great Bukharia, in the province of Balkh, situated at the foot of those high mountains which separate Indostan from Great Tartary. The city is exceedingly strong by its situation; and belongs to the khan of proper Bukharia, who uses it as a kind of state-prison to secure those he is jealous of. The town is not very big, but well built, and very populous. It stands on the north side of the river Amu, about 100 miles from its source, and is a great thoroughfare for the caravans designed for little Bukharia. The inhabitants are enriched by mines of gold, silver, and rubies, which are in the neighbourhood; and those who live at the foot of the mountains gather a great quantity of gold and silver dust brought down in the spring by torrents occasioned by the melting of the snow on the top.

BADAJOZ, a large and strong town, capital of Estremadura in Spain. It is seated on the river Guadiana, over which there is a fine bridge built by the Romans. On this bridge the Portuguese were defeated in 1661, by Don John of Austria. W. Long. 7. 3. N. Lat. 38. 35.

BADELONA, a town of Catalonia in Spain, seated on the Mediterranean. Lord Peterborough landed here in 1704, when, with Charles then king of Spain, he laid siege to Barcelona, from which it is ten miles distant. E. Long. 2. 20. N. Lat. 41. 12.

BADEN (the district of), in Swisserland, has three cities, Baden, Keisers-Stoul, and Klingnaw, besides a town that passes for a city, namely, *Zurzach*. It is one of the finest countries in Swisserland; and is watered with three navigable rivers, the Limmet, Russ, and Are. The land is fertile in corn and fruit, and there are places on the sides of the Limmet which produces wine. It maintains a communication between the cantons of Zurich and Bern, being seated between their north extremities. It extends on one side to the Are, as far as the place where it falls into the Rhine, and on the other side beyond the Rhine, where there are some villages which depend thereon. Most of the inhabitants are Papists. By the treaty of peace at the conclusion of the war which broke out in 1712 between the Protestant and Popish cantons, this country was yielded to the Protestant cantons of Zurich and Bern. Before, it was the property of the eight old cantons; however, as the canton of Glaris had taken no part in this war, by the consent of both parties its right was still continued.

BADEN, the capital of the above district, is an agreeable city, moderately large, seated on the side of the Limmet, in a plain flanked by two high hills, between which the river runs. This city owes its rise to its baths, which were famous before the Christian æra. Several monuments of antiquity have been found here from time to time, particularly in 1420. When they were opening the large spring of the baths, they found statues of several heathen gods, made of alabaster; Roman coins, made of bronze, of Augustus, Vespasian, Decius, &c.; and several medals of the Roman emperors, of gold, silver, copper, and bronze. There are two churchs in Baden; one of which is collegiate, and makes a good appearance; the other is a monastery of the Capuchins, near the town-house. This last building serves not only for the assemblies of their own council, but also for those of the cantons. The diet assembles there in a handsome room made for that purpose; the deputies of Zurich sit at the bottom behind a table, as the most honourable place; the ambassadors of foreign powers are seated on one side to the right, and the deputies of the other cantons are ranged on each side the room. The bailiff of Baden resides in a castle at the end of a handsome wooden bridge, which is covered in. Before this castle there is a stone pillar, erected in honour of the emperor Trajan, who paved a road in this country 85 Italian miles in length. The inhabitants are rigid Roman catholics, and formerly behaved in a most insolent manner to the Protestants, but they are now obliged by their masters to be more submissive. The baths which are on each side the river are a quarter of a league from the city. Joining to the small baths there is a village, and to the large a town which may pass for a second Baden. It is seated on a hill, of which the ascent is steep. There the baths are brought into inns and private houses, by means

means of pipes, which are about 60 in all. There are alſo public baths in the middle of the town, from a ſpring which riſes in the ſtreet, where the poor bathe *gratis*, but they are expoſed quite naked to all that paſs by. All the baths are hot, and one to ſo great a degree as to ſcald the hand; and they are impregnated with a great deal of ſulphur, with ſome alum and nitre. They are uſeful for drinking as well as bathing; and are ſaid to cure all diſeaſes from a cold cauſe, head-achs, vertigos, &c. They ſtrengthen the ſenſes, cure diſeaſes of the breaſt and bowels, aſthmas, and obſtructions. They are peculiarly excellent for women's diſeaſes. E. Long. 8. 25. N. Lat. 47. 27.

Baden (the Margravate of), in the circle of Swabia, in Germany, is bounded by the Palatinate of the Rhine, on the north; by the Black Foreſt, on the eaſt; by Swiſſerland, on the ſouth; and by the Rhine, which divides it from Alſace, on the eaſt: and is about 90 miles in length, from north to ſouth; but not above 20 in breadth, where it is wideſt. It is a very populous and fruitful country, abounding in corn and wine. Veniſon and wild fowl are ſo plentiful, that they are the common diet of the peaſants. The rivers that water this territory, are the Rhine, Ens, Wirmbs, and Phints, which yield plenty of fiſh. They feed their hogs with cheſnuts, which make the bacon excellent. They have free-ſtone for building, and marble of all colours. They have ſome agate, and great quantities of hemp and flax for exportation. The chief towns are Baden, Durlach, Stolhafen, Raſtadt, Gerſbach, Pforſheim, and Horchberg.

Baden, the chief city of the above margravate, has a caſtle that ſtands on the top of a hill, which is the reſidence of a prince. The town is ſeated among hills, on rocky and uneven ground, which renders the ſtreets inconvenient and crooked. It is famous for its baths, the ſprings of which are ſaid to be above 300. Some of them are hot, and accounted to be very good in nervous caſes. They partake of ſalt, alum, and ſulphur. E. Long. 9. 24. N. Lat. 48. 50.

Baden, a town of Germany, in the arch-duchy of Auſtria, ſeated on the Little Suechat, is a neat little walled town, ſtanding in a plain not far from a ridge of hills which run out from the mountain Cetius. It is much frequented by the people of Vienna, and the neighbouring parts, on account of its baths. The ſprings ſupply two convenient baths within the town, five without the walls, and one beyond the river. They are good for diſtempers of the head, the gout, dropſy, and moſt chronic diſeaſes. E. Long. 17. 10. N. Lat. 48. 0.

BADENOCH, the moſt eaſterly part of Inverneſs-ſhire, in Scotland, extending about 33 miles in length from eaſt to weſt, and 27 from north-eaſt to ſouth-weſt where broadeſt. It has no conſiderable town, and is very barren and hilly, but abounds with deer, and other kinds of game.

BADEN-weiller, a town of Germany, belonging to the lower Margravate of Baden. E. Long. 7. 50. N. Lat. 47. 55.

BADENS (Francis), hiſtorical and portrait painter, was born at Antwerp in 1571, and the firſt rudiments of the art were communicated to him by his father, who was but an ordinary artiſt. However, he viſited Rome, and ſeveral parts of Italy, and there formed a good taſte of deſign, and a manner exceedingly pleaſing. When he returned to his own country his merit procured for him great employment, and ſtill greater reputation, and he was uſually diſtinguiſhed by the name of the Italian painter. His touch was light and ſpirited, and his colouring warm; and he had the honour of being the firſt who introduced a good taſte of colouring among his countrymen. While his acknowledged merit was rewarded with every public teſtimony of eſteem and applauſe, unhappily he received an account of the death of his brother, who had been aſſaſſinated on a journey; and the intelligence affected him ſo violently, that it occaſioned his own death, to the inexpreſſible regret of every lover of the art, in 1603.

BADGE, in naval architecture, ſignifies a ſort of ornament placed on the outſide of a ſmall ſhips, very near the ſtern, containing either a window for the convenience of the cabin, or a repreſentation of it. It is commonly decorated with marine figures, martial inſtruments, or ſuch like emblems.

BADGER, in zoology, the Engliſh name for a ſpecies of urſus. See Ursus.

Badger, in old law-books, one that was licenſed to buy corn in one place and carry it to another to ſell, without incurring the puniſhment of an engroſſer.

BADIA, an ancient town of Bætica on the Anas; now ſuppoſed to be Badajoz on the Guadiana.

BADIAGA, in the materia medica, the name of a ſort of ſpongy plant, common in the ſhops in Moſcow, and ſome other northern kingdoms. The uſe of it is the taking away the livid marks from blows and bruiſes, which the powder of this plant is ſaid to do in a night's time.

BADIANE, or Bandian, the ſeed of a tree which grows in China, and ſmells like aniſe-ſeed. The Chineſe, and the Dutch in imitation of them, ſometimes uſe the badiane to give their tea an aromatic taſte.

BADIGEON, a mixture of plaſter and free-ſtone, well ground together, and ſifted; uſed by ſtatuaries to fill up the little holes, and repair the defects in ſtones, whereof they make their ſtatues and other work.

The ſame term is alſo uſed by joiners, for ſaw-duſt mixed with ſtrong glue, wherewith they fill up the chaps and other defects in wood, after it is wrought.

BADILE (Antonio), hiſtory and portrait painter, was born at Verona in 1480, and by great ſtudy and application acquired a more extenſive knowledge of the true principles of painting than any of his predeceſſors. He was confeſſedly a moſt eminent artiſt; but he derived greater honour from having two ſuch diſciples as Paolo Veroneſe and Baptiſta Zelotti, than he did even from the excellence of his own compoſitions. He died in 1560. His colouring was admirably good; his carnations beautiful; and his portraits preſerved the perfect reſemblance of fleſh and real life; nor had he any cauſe to envy the acknowledged merit of Titian, Giorgione, or the beſt of his cotemporaries.

BADIS, a fortreſs of Livonia, ſubject to Ruſſia. E. Long. 23. 10. N. Lat. 59. 15.

BADIUS (Conrad), and (Stephen Robert), his brother; French refugees; celebrated as printers at Geneva, and Conrad as an author. The latter died in 1566.

BÆCKEA, in botany: A genus of the octandria order, belonging to the monogynia class of plants. The calyx is a permanent perianthium, consisting of a single funnel-shaped leaf, cut in five segments at the brim; the corolla consists of five roundish spreading petals inserted into the calyx; the pericarpium is a globose capsule, made up of four valves, and containing four cells, in which are a few roundish angular seeds.

BÆTERRÆ, an ancient town of the Tertosages in Gallia Narbonensis; now *Besiers*, on the east bank of the Obris, now *Orbis*, or *Orbe*, in Lower Languedoc.

BÆTICA, a province of ancient Spain, so called from the famed river Bætis, afterwards *Tartessus*, now *Guadalquiver*, or the great river. It was bounded on the west by Lusitania; on the south, by the Mediterranean, and Sinus Gaditanus; on the north, by the Cantabric sea, now the Bay of Biscay. On the east and north-east, its limits cannot be so well ascertained, as they are very reasonably thought to have been in a continual state of fluctuation, as each petty monarch had an opportunity of encroaching upon his neighbour. The province was divided in two by the river Bætis already mentioned. On the one side of which, towards the Anas, were situated the Turdetani, from whence the kingdom was called *Turdetania*, though more generally known by the name of *Bæturia*. On the other side were situated the Bastuli, Bastetani, and Contestani, along the Mediterranean coasts. The Bastuli were supposed to be of Phœnician extract, and dwelt along the coasts of the Mediterranean, till driven from thence by the Moors, they fled into the mountainous parts of Galicia, which they then called from their own name *Bastulia*. The Bastetani were seated higher up, on the same coasts. The territories of both these made part of what has since become the kingdom of *Granada;* in which there is a ridge of very high mountains called from the abovementioned people, the *Bastetanian mountains*. Mention is also made of their capital *Bastetana;* a place of such strength, that King Ferdinand was six months besieging it before he could take it from the Moors.—The whole province of Bætica, according to the most probable account, contained what is now called *Andalusia*, part of the kingdom of Grenada, and the outward boundaries of Estremadura.

BÆTIS. See Bætica.

BÆTULO, a town of ancient Spain, in the Terraconensis; now *Badelona* in Catalonia.

BÆTYLIA, anointed stones, worshipped by the Phœnicians, by the Greeks before the time of Cecrops, and by other babarous nations. They were commonly of a black colour, and consecrated to some god, as Saturn, Jupiter, the Sun, &c.—Some are of opinion that the true original of these idols is to be derived from the pillar of stone which Jacob erected at Bethel, and which was afterwards worshipped by the Jews.

These *bætylia* were much the object of the veneration of the ancient heathens. Many of their idols were no other. In reality, no sort of idol was more common in the eastern countries, than that of oblong stones erected, and hence termed by the Greeks, *κιονες*, *pillars*. In some parts of Egypt they were planted on both sides of the highways. In the temple of of Heliogabulus, in Syria, there was one pretended to have fallen from heaven. There was also a famous black stone in Phrygia, said to have fallen from heaven. The Romans sent for it and the priests belonging to it with much ceremony, Scipio Nasika being at the head of the embassy.

BÆZA, a city of Andalusia in Spain, seated on a high hill three miles from the Gaudalquiver; it is the see of a bishop, and has a kind of university founded by John d'Avila. It was taken from the Moors about the end of the 15th century. E. Long. 3. 15. N. Lat. 37. 45.

BAFFETAS, or Bastas, a cloth made of coarse white cotton-thread, which comes from the East Indies. That of Surat is the best.

BAFFIN's bay, a gulph of North America, running north-east from Cape Farewel in West Greenland, from 60° to 80° of north latitude.

BAFFO, a considerable town in the island of Cyprus, with a fort built near ancient Paphos, of which some considerable ruins yet remain, particularly some broken columns, which probably belonged to the temple of Venus. E. Long. 32. 20. N. Lat. 34. 50.

BAG, in commerce, a term signifying a certain quantity of some particular commodity: a bag of almonds, for instance, is about 300 weight; of aniseseeds, from 300 to 400, &c.

Bags are used in most countries to put several sorts of coin in, either of gold, silver, brass, or copper. Bankers, and others, who deal much in current cash, label their bags of money, by tying a ticket or note at the mouth of the bag, signifying the coin therein contained, the sum total, its weight, and of whom it was received. Tare is allowed for the bag.

Bag, among farriers, is when, in order to retrieve a horse's lost appetite, they put in an ounce of asa-fœtida, and as much powder of savin, into a bag, to be tied to the bit, keeping him bridled for two hours, several times a-day; as soon as the bag is taken off, he will fall to eating. The same bag will serve a long time.

BAGAMADER, or Bagamedri, a province of the kingdom of Abyssinia in Africa. It is said to receive its name from the great number of sheep bred in it; *meder* signifying land or earth, and *bag* a sheep. Its length is estimated about 60 leagues, and its breadth 20: but formerly it was much more extensive; several of its provinces having been dismembered from it, and joined to that of Tigre. A great part of it, especially towards the east, is inhabited by wandering Gallas and Caffres.

BAGAUDÆ, or Bacaudæ, an ancient faction of peasants, or malecontents, who ravaged Gaul. The Gauls being oppressed with taxes, rose about the year of Christ 290, under the command of Amand and Elian; and assumed the name *bagaudæ*, which, according to some authors, signified in the Gallic language *forced rebels;* according to other, *tribute;* according to others, *robers;* which last signification others allow the word had, but then it was only after the time of the *bagaudæ*, and doubtless took its rise from them.

BAGDAD, a celebrated city of Asia in Irak Arabi, seated on the eastern banks of the Tigris, in E. Long. 43. 40. N. Lat. 33. 15. By many authors this city is very improperly called *Babylon*. The latter stood on the Euphrates at a considerable distance.

This city, for many years the capital of the Saracen empire,

empire, was founded by the khalif Al Manſur, the ſecond of the houſe of Al Abbas, after an attempt by the Rawandians to aſſaſſinate him, as already mentioned. See ARABIA, n° 184.

1 Why the city was built.

The reaſons aſſigned by the Arabian hiſtorians for building the city of Bagdad are, That the abovementioned attempt to aſſaſſinate the khalif had diſguſted him at his Arabian ſubjects in general, and that the ſpot where Bagdad ſtood was at a conſiderable diſtance from the city of Cufa particularly; the inhabitants of which were remarkable for their treachery and inconſtancy, Al Manſur himſelf having felt ſeveral inſtances of it. Beſides, the people of Irak, who had always continued faithful to him, repreſented, that by building his capital near the confluence of the Euphrates and Tigris, it would be in a great meaſure ſecured from the inſults and attacks of thoſe who ſhould have an inclination to diſpute the kalifat with him; and that by being ſituated as it were in the middle of the tract comprehending the diſtricts of Baſra, Cufa, Waſet, Mawſel, and Swada, at no great diſtance from thoſe cities, it would be plentifully ſupplied with proviſions by means of the aforeſaid rivers.

2 Ancient city deſcribed.

Concerning the origin of the name *Bagdad*, there are various accounts, which being equally uncertain and trifling, merit no attention. The firſt city that went by this name was ſituated on the weſtern bank of the Tigris; from whence Al Manſur diſpatched his ſon Al Mohdi with a body of Moſlem troops, to the oppoſite bank. Here the young prince took poſt, and fortified the place on which he had encamped with a wall, in order to cover his troops, as well as the workmen employed by his father on the other ſide of the river, from the incurſions of the Perſians, who ſeemed to have taken umbrage at the erection of a new metropolis ſo near the frontiers of their dominions. Hence that part of the city ſoon afterwards built on the eaſtern banks of the Tigris, received the name of the *Camp*, or *Fortreſs of Al Mohdi*. The khalif had a ſuperb and magnificent palace both in the eaſtern and weſtern part of the town. The eaſtern palace was ſurrounded on the land-ſide by a ſemicircular wall that had ſix gates; the principal of which ſeems to have been called *the gate of prefects*, whoſe entrance was generally kiſſed by the princes and ambaſſadors that came to the khalif's court. The weſtern part of the city was entirely round, with the khalif's palace in the centre, and having the great moſque annexed to it. The eaſtern part conſiſted of an interior and exterior town, each of which was ſurrounded by a wall. For ſome time the building of the city went but ſlowly on, owing to a ſcarcity of materials for building; for which reaſon the khalif was ſometimes inclined to remove the materials of Al Madayen the ancient metropolis of the Perſian empire. But, upon trial, he found the ſtones to be of ſuch an immenſe ſize, that the removal of them to Bagdad would be attended with great difficulty and expence; beſides, he conſidered that it would be a reflection upon himſelf to have it ſaid that he could not finiſh his metropolis without deſtroying ſuch a pile of building as perhaps could not be paralleled in the whole world; for which reaſons he at length gave over his deſign, and erected the city of Bagdad, moſt probably out of the ruins of the ancient cities of Seleucia and Cteſiphon, putting an end to his undertaking in the 149th year of the Hegira, or four years after the city was begun.

From the building the city of Bagdad to the death of Al Manſur, nothing very remarkable happened, excepting ſome irruptions made into the territories of the Greeks, and by the Arabs into ſome of the khalif's other territories. In the 157th year of the Hegira alſo, a grievous famine was felt in Meſopotamia, which was quickly after followed by a plague that deſtroyed great numbers. This year likewiſe, the Chriſtians, who had been all along very ſeverely dealt with by Al Manſur, were treated with the utmoſt rigour by Muſa Ebn Moſaab the khalif's governor; every one who was unable to pay the enormous tribute exacted of them being thrown into priſon without diſtinction.

3 Death of Al Manſur.

The next year being the 158th of the Hegira, the khalif ſet out from Bagdad, in order to perform the pilgrimage to Mecca: but being taken ill on the road, he expired at Bir Maimun, whence his body was carried to Mecca; where, after 100 graves had been dug, that his ſepulchre might be concealed, he was interred, having lived, according to ſome 63, according to others 68 years, and reigned 22. He is ſaid to have been extremely covetous, and to have left in his treaſury 600,000,000 dirhems, and 24,000,000 dinars. He is reported to have paid his cook by aſſigning him the heads and legs of the animals dreſſed in his kitchen, and to have obliged him to procure at his own expence all the fuel and veſſels he had occaſion for.

4 Succeeded by Al Mohdi.

When Al Manſur expired at Bir Maimun, he had only his domeſtics and Rabi his freedman with him. The latter of theſe, for ſome time, kept his death concealed, and pretended to have a conference with him; in which, as he gave out, the khalif commanded him to exact an oath of allegiance to Al Mohdi his ſon, as his immediate ſucceſſor, and to Iſa Ebn Muſa his couſin-german, as the next apparent heir to the crown. He then diſpatched a courier to Bagdad with the news of Al Manſur's death; upon which Al Mohdi was unanimouſly proclaimed khalif. Iſa Ebn Muſa, however, no ſooner heard this news, than he began to entertain thoughts of ſetting up for himſelf at Cufa, where he then reſided; and in order to facilitate the execution of his ſcheme, fortified himſelf in that city. but Al Moluda being apprized of his defection, ſent a detachment of 1000 horſe to bring him to Bagdad; which being done, Al Mohdi not only prevailed upon him to own his allegiance to him, but alſo to give up his right to the ſucceſſion for 10,000 according to ſome, or, according to others, for 10,000,000, dinars.

5 Rebellion of Al Mokanna.

From the acceſſion of Al Mohdi to the 164th year of the Hegira, the moſt remarkable event was the rebellion of Al Mokanna. This impious impoſtor, whoſe true name was *Hakem Ebn Heſham*, came originally from Khoraſan, and had been an under ſecretary to Abu Moſlem governor of that province. He afterwards turned ſoldier, and paſſed thence into Mawaralnah, where he gave himſelf out for a prophet. The name of Al Mokanna, as alſo that of Al Borkai, that is, the *veiled*, he took from his cuſtom of covering his face with a veil or girdle maſk, to conceal his deformity; he having loſt an eye in the wars, and being otherwiſe of a deſpicable appearance; though his followers pretended he did this for the ſame reaſon that

Bagdad.

Moſes did, viz. leſt the ſplendor of his countenance ſhould dazzle the eyes of his beholders. In ſome places he made a great many proſelytes, deluding the people with a number of juggling tricks which they ſwallowed as miracles, and particularly by cauſing the appearance of a moon to riſe out of a well for many nights together; whence he was alſo called in the Perſian tongue, *Sazendeh mak*, or the *moon-maker*. This wretch, not content with being reckoned a prophet, arrogated to himſelf divine honours; pretending that the Deity reſided in his perſon, having proceeded to him from Abu Moſlem, in whom he had taken up his reſidence before. At laſt this impoſtor raiſed an open rebellion again the khalif, and made himſelf maſter of ſeveral fortified places in Khoraſan, ſo that Al Mohdi was obliged to ſend one of his generals with an army againſt him. Upon the approach of the khalif's troops, Al Mokanna retired into one of his ſtrong fortreſſes which he had well provided for a ſiege; and ſent his emiſſaries abroad to perſuade the people that

6 he raiſed the dead to life, and foretold future events.

Dreadful cataſtrophe of him and his family.

But being cloſely beſieged by the khalif's forces, and ſeeing no poſſibility of eſcaping, he gave poiſon in wine to his whole family and all that were with him in the caſtle; when they were dead, he burnt their bodies, together with all their furniture, proviſions, and cattle; and laſtly, he threw himſelf into the flames, or, as others ſay, into a tub of aqua-fortis, or ſome other preparation, which conſumed every part of him except the hair. When the beſiegers therefore entered the place, they found no living creature in it, except one of Al Mokanna's concubines, who, ſuſpecting his deſign, had hid herſelf, and now diſcovered the whole matter. This terrible contrivance, however, failed not to produce the deſired effect. He had promiſed his followers, that his ſoul ſhould tranſmigrate into the form of an old man, riding on a greyiſh coloured beaſt, and that after ſo many years he would return and give them the earth for their poſſeſſion; which ridiculous expectation kept the ſect in being for ſeveral years.

7 Harun Alraſhid's ſucceſs againſt the Greeks.

All this time war had been carried on with the Greeks, but without any remarkable ſucceſs on either ſide. In the 164th year of the Hegira, however, Al Mohdi ordered his ſon Harun Al Raſhid to penetrate into the Greek territories with an army of 95,000 men. Harun, then, having entered the dominions of the empreſs Irene, defeated one of her commanders that advanced againſt him; after which he laid waſte ſeveral of the imperial provinces with fire and ſword, and even threatened the city of Conſtantinople itſelf. By this the empreſs was ſo terrified, that ſhe purchaſed a peace with the khalif by paying him an annual tribute of 70,000 pieces of gold; which, for the preſent at leaſt, delivered her from the depredations of theſe barbarians. After the ſigning of the treaty, Harun returned

8 home laden with ſpoil and glory. This year, according to ſome of the oriental hiſtorians, the ſun, one day,

Unaccountable darkneſs.

a little after his riſing, totally loſt his light in a moment, without being eclipſed, when neither any fog nor any cloud of duſt appeared to obſcure him. This frightful darkneſs continued till noon, to the great aſtoniſhment of the people ſettled in the countries where it happened*.

In the 169th year of the Hegira, Al Mohdi was poiſoned, though undeſignedly, by one of his concubines named *Haſanah*. She had deſigned to deſtroy one of her rivals, whom ſhe imagined to have too great an aſcendant over the khalif, by giving her a poiſoned pear. This the latter, not ſuſpecting any thing, gave to the khalif; who had no ſooner eaten it than he felt himſelf in exquiſite torture, and ſoon after expired.

9 Al Mohdi poiſoned.

10 As likewiſe his ſucceſſor Al Hadi.

On the death of Al Mohdi, he was ſucceeded by his eldeſt ſon Al Hadi; who having formed a deſign to deprive his younger brother Harun Al Raſhid of his right of ſucceſſion, and even to aſſaſſinate him, was poiſoned by his vizier in the 170th year of the Hegira; and on his death the celebrated khalif Harun Alraſhid aſcended the throne.

11 Harun Al Raſhid khalif.

This was one of the beſt and wiſeſt princes that ever ſat on the throne of Bagdad. He was alſo extremely fortunate in all his undertakings, tho' he did not much extend his dominions by conqueſt. In his time the Moſlem empire may be ſaid to have been in its moſt flouriſhing ſtate, though, by the independency of the Moſlems in Spain, who had formerly ſet up a khalif of the houſe of Ommiyah, his territories were not quite ſo extenſive as thoſe of ſome of his predeceſſors. He poſſeſſed the provinces of Syria, Paleſtine, Arabia, Perſia, Armenia, Natolia, Media or *Aderbijan*, Babylonia, Aſſyria, Sindia, Sijiſtan, Khoraſan, Tabreſtan, Jorjan, Zableſtan, or *Sableſtan*, Mawaralnahr, or *Great Bukharia*, Egypt, Lybia, Mauritania, &c.; ſo that his empire was by far the moſt powerful of any in the world, and extended farther than the Roman empire ever had done.

12 Extent of his empire.

13 He finds a ring he had thrown into the Tigris.

The firſt inſtance of Harun's good fortune, and which was taken for a preſage of a proſperous and happy reign, was his finding a valuable ring which he had thrown into the Tigris to avoid being deprived of it by his brother Al Hadi. He was able to give the divers no other direction than by throwing a ſtone from the bridge of Bagdad, about the ſame place of the river in which he had thrown the ring: notwithſtanding which, they found it without any great difficulty.

14 Divides the empire among his ſons, and ſettles the ſucceſſion.

In the 186th year of the Hegira, beginning January 10th, 802, the khalif divided the government of his extenſive dominions among his three ſons in the following manner: To Al Amin the eldeſt, he aſſigned the provinces of Syria, Irak, the three Arabias, Meſopotamia, Aſſyria, Media, Paleſtine, Egypt, and all that part of Africa extending from the confines of Egypt and Ethiopia to the ſtraits of Gibraltar, with the dignity of khalif; to Al Mamun the ſecond, he aſſigned Perſia, Kerman, the Indies, Khoraſan, Tabreſtan, Cableſtan and Zableſtan, together with the vaſt province of Mawaralnahr; and to his third ſon Al Kaſem, he gave Armenia, Natolia, Jorjan, Georgia, Circaſſia, and all the Moſlem territories bordering upon the Euxine ſea. As to the order of ſucceſſion, Al Amin was to aſcend the throne immediately after his father's deceaſe; after him Al Mamun; and then Al Kaſem, whom he had ſurnamed *Al Mutaman*.

15 His ſucceſsful wars with the Greeks.

The moſt conſiderable exploits performed by this khalif were againſt the Greeks, who by their perfidy provoked him to make war upon them, and whom he always overcame. In the 187th year of the Hegira, the khalif received a letter from the Greek emperor Neciphorus

* See *Aſtronomy*, n° 57 and 486.

Bagdad. Nicephorus soon after he had been advanced to the imperial dignity, commanding him to return all the money he had extorted from the empress Irene, though that had been secured to him by the last treaty concluded with that princess, or expect soon to see an imperial army in the heart of his territories. This insolent letter so exasperated Harun, that he immediately assembled his forces and advanced to Heraclea, laying the country through which he passed waste with fire and sword. For some time also he kept that city straitly besieged; which so terrified the Greek emperor, that he submitted to pay an annual tribute. Upon this Harun granted him a peace, and returned with his army. But a hard frost soon after happening in these parts, Nicephorus took for granted that Al Rashid would not pay him another visit, and therefore broke the treaty he had concluded. Of this the khalif receiving advice, he instantly put himself in motion; and, notwithstanding the inclemency of the weather, forced the emperor to accept of the terms proposed. According to a Persian historian, before the hostilities at this time commenced, Nicephorus made the khalif a present of several fine swords, giving him thereby plainly to understand that he was more inclinable to come to blows than to make peace with him. All these swords Harun cut asunder with his famous sword *Samsamah*, as if they had been so many radishes, after which severe proof there did not appear the least flaw in the blade; a clear proof of the goodness of the sword, as the cutting the others with it was of the strength of Harun's arm. This sword had fallen into Al Rashid's hands among the spoils of Ebn Dakikan, one of the last Hamyaritic princes of Yaman; but is said to have belonged originally to a valiant Arab named *Amru Ebn Maadi Carb*, by whose name it generally went among the Moslems. This man is said to have performed very extraordinary feats with his sword, which induced a certain prince to borrow it from him; but he not being able to perform any thing remarkable with it, complained to Amru that it had not the desired effect: upon which that brave man took the liberty to tell him, that he had not sent his arm along with his sword.

In the 188th year of the Hegira, war was renewed with the Greeks, and Nicephorus with a great army attacked the khalif's forces with the utmost fury. He was, however, defeated with the loss of 40,000 men, and received three wounds in the action; after which the Moslems committed terrible ravages in his territories, and returned home laden with spoils. The next year Harun invaded Phrygia; defeated an imperial army sent to oppose him; and having ravaged the country, returned without any considerable loss. In the 190th year of the Hegira, commencing November 27th, 805, the khalif marched into the Imperial territories with an army of 135,000 men, besides a great number of volunteers and others who were not inrolled among his troops. He first took the city of Heraclea, from whence he is said to have carried 16,000 prisoners; after which he made himself master of several other places; and, in the conclusion of the expedition, he made a descent on the island of Cyprus, which he plundered in a terrible manner. This success so intimidated Nicephorus, that he immediately sent the tribute due to Harun, the withholding of which had been the cause of the war; and concludes a peace upon the khalif's own terms; one of which was, that the city of Heraclea should never be rebuilt. This perhaps Harun would not have so readily granted, had not one Rafe Ebn Al Leith revolted against him at Samarcand, and assembled a considerable force to support him in his defection. Bagdad. 16 Rebellion in Khorasan.

The next year, being the 191st of the Hegira, the khalif removed the governor of Khorasan from his employment because he had not been sufficiently attentive to the motions of the rebel Rafe Ebn Al Leith. As this governor had also tyranized over his subjects in the most cruel manner, his successor no sooner arrived than he sent him in chains to the khalif: but notwithstanding all Harun's care, the rebels made this year a great progress in the conquest of Khorasan.

Next year, the khalif found it necessary to march in person against the rebels, who were daily becoming more formidable. The general rendezvous of his troops was in the plains of Rakka, from whence he advanced at the head of them to Bagdad. Having at that place supplied the troops with every thing necessary, he continued his march to the frontiers of Jorjan, where he was seized with an illness which grew more violent after he had entered that province. Finding himself therefore unable to pursue his journey, he resigned the command of the army to his son Al Mamun, retiring himself to Tus in Khorasan. We are told by Khondemir, that, before the khalif departed from Rakka, he had a dream wherein he saw a hand over his head full of red earth, and at the same time heard a person pronouncing these words, "See the earth where Harun is to be buried." Upon this he demanded where he was to be buried; and was instantly answered, "At Tus." This dream greatly discomposing him, he communicated it to his chief physician, who endeavoured to divert him, telling the khalif that the dream had been occasioned by the thoughts of his expedition against the rebels. He therefore advised him to pursue some favourite diversion that might draw his attention another way. The khalif accordingly, by his physician's advice, prepared a magnificent regale for his courtiers, which lasted several days. After this, he put himself at the head of his forces, and advanced to the confines of Jorjan, where he was attacked by the distemper that proved fatal to him. As his disorder increased, he found himself obliged to retire to Tus; where being arrived, he sent for his physician, and said to him, "Gabriel, do you remember my dream at Rakka? we are now arrived at Tus, the place, according to what was predicted in that dream, of my interment. Send one of my eunuchs to fetch me a handful of earth in the neighbourhood of this city." Upon this, *Masrur*, one of his favourite eunuchs, was dispatched to bring a little of the soil of the place to the khalif. He soon returned, and brought a handful of red earth, which he presented to the khalif with his arm half bare. At the sight of this, Harun instantly cried out, "In truth this is the earth, and this the very arm, that I saw in my dream." His spirits immediately failing, and his malady being greatly increased by the perturbation of mind ensuing upon this sight, he died three days after, and was buried in the same place. According to Abul Faraj, Bashir Ebn Al Leith the arch-rebel's brother, was brought in chains to the khalif, who was then at the point of death. At the sight of whom Harun declared, that if

17 The khalif's death predicted by a dream.

18 He dies according to the prediction.

 if he could ſpeak only two words he would ſay *kill him;* and immediately ordered him to be cut to pieces in his preſence. This being done, the khalif ſoon after expired, in the year of the Hegira 193, having reigned 23 years. The diſtemper that put an end to his days

19 is ſaid to have been the bloody flux.

Succeeded by his ſon Al Amin.

Upon the arrival of a courier from Tus, with the news of Al Raſhid's death, his ſon Al Amin was immediately proclaimed khalif; and was no ſooner ſeated on the throne, than he formed a deſign of excluding his brother Al Mamun from the ſucceſſion. Accordingly he deprived him of the furniture of the imperial palace of Khoraſan; and in open violation of his father's will, who had beſtowed on Al Mamun the perpetual government of Khoraſan; and of all the troops in that province, he ordered theſe forces to march directly to Bagdad. Upon the arrival of this order, Al Mamun expoſtulated with the general Al Fadl Ebn Rabi who commanded his troops, and endeavoured to prevent his marching to Bagdad; but without effect, for he punctually obeyed the orders ſent by the khalif. Al Mamun, however, took care not to be wanting in fidelity to his brother. He obliged the people of Khoraſan to take an oath of fidelity to Al Amin, and reduced ſome who had actually excited a conſiderable body of the people to revolt, while the general Al Fadl having ingratiated himſelf with the khalif by his ready compliance with his orders, was choſen prime vizir, and go-

20 verned with an abſolute ſway; Al Amin abandoning himſelf entirely to drunkenneſs.

Infamous behaviour of the new khalif.

Al Fadl was a very able miniſter; though fearing Al Mamun's reſentment if ever he ſhould aſcend the throne, he gave Al Amin ſuch advice as proved in the end the ruin of them both. He told him that his brother had gained the affection of the people of Khoraſan by the good order and police he had eſtabliſhed among them; that his unwearied application to the adminiſtration of juſtice had ſo attracted their eſteem, that the whole province was entirely at his devotion; that his own conduct was by no means reliſhed by his ſubjects, whoſe minds were almoſt totally alienated from him; and therefore that he had but one part to act, which was to deprive Al Mamun of the right of ſucceſſion that had been given him by his father, and transfer it to his own ſon Muſa, though then but an infant. Agreeable to this pernicious advice, the khalif ſent for his brother Al Kaſem from from Meſopotamia, and recalled Al Mamun from Khoraſan, pretending he had occaſion for him as an aſſiſtant in his councils.

21

Al Mamun takes up arms againſt his brother.

By this treatment Al Mamun was ſo much provoked, that he reſolved to come to an open rupture with his brother, in order, if poſſible, to fruſtrate his wicked deſigns. Inſtead, therefore, of going to Bagdad as he had been commanded, he cut off all communication between his own province and that capital; pretending, that as his father Harun had aſſigned him the lieutenancy of Khoraſan, he was reſponſible for all the diſorders that might happen there during his abſence. He alſo coined money, and would not ſuffer Al Amin's name to be impreſſed upon any of the dirhems or dinars ſtruck in that province. Not content with this, he prevailed upon Rafe' Ebn Al Leith, who had been for ſome time in rebellion, to join him with a body of troops; whoſe example was ſoon after followed by Harthema Ebn Aafan; which put him in poſſeſſion of all the vaſt territory of Khoraſan. Here he governed with an abſolute ſway, officiated in the moſque as *Iman*, and from the pulpit conſtantly harangued the people.

The following year, being the 195th year of the Hegira, beginning October 4th, 810, the khalif Al Amin, finding that his brother ſet him at defiance, declared war againſt him, and ſent his general Ali Ebn Iſa with an army of 60,000 men to invade Khoraſan. Al Mamun, being informed that Ali was advancing againſt him with ſuch a powerful army, put on foot all the troops he could raiſe, and gave the command to Thaher Ebn Hoſein, one of the greateſt generals of his age. Thaher being a man of undaunted reſolution, choſe only 4000 men, whom he led againſt Al Amin's army. Ali, ſeeing ſo ſmall a number of troops advancing againſt him, was tranſported with joy, and promiſed himſelf an eaſy victory. Deſpiſing his enemies, 22

therefore, he behaved in a ſecure and careleſs manner; the conſequence of which was, that his army was entirely defeated, and himſelf killed, his head being afterwards ſent as a preſent to Al Mamun, who amply rewarded Thaher and Harthema for their ſervices.

Al Amin's forces defeated.

After this victory, Al Mamun aſſumed the title of *khalif*, ordered Al Amin's name to be omitted in the public prayers, and made all neceſſary preparations for carrying the war into the very heart of his brother's dominions. For this purpoſe he divided his forces into two bodies, and commanded them to march into Irak by different routes. One of them obeyed the orders of Thaher, and the other of Harthema. The firſt directed his march towards Ahwas, and the other towards Holwan, both of them propoſing to meet in the neighbourhood of Bagdad, and after their junction to beſiege that city. 23

Al Mamun's rapid conqueſts.

In the 196th year of the Hegira, Thaher Ebn Hoſein made a moſt rapid progreſs with the troops under his command. Having advanced towards Ahwas, he there defeated a body of the khalif's forces; and though the victory was by no means deciſive, it ſo intimidated the commander of Ahwas, that he thought fit to ſurrender that fortreſs to him. This opened him a way to Waſet upon the Tigris, and facilitated the conqueſt of that place. After this he marched with his army to Al Madayen; the inhabitants of which immediately opened their gates to him. The rapidity of theſe conqueſts, and the infamous conduct of Al Amin, excited the people of Egypt, Syria, Hejaz, and Yaman, unanimouſly to declare for Al Mamun; who was accordingly proclaimed khalif in all theſe provinces. 24

Siege of Bagdad.

The next year, Al Mamun's forces under Thaher and Harthema laid ſiege to Bagdad. As the khalif was ſhut up in that place, and it had a numerous garriſon, the beſieged made a vigorous defence, and deſtroyed a great number of their enemies. The beſiegers, however, inceſſantly played upon the town with their catapults and other engines, though they were in their turn not a little annoyed by the garriſon with the ſame ſort of military machines. The latter likewiſe made continual ſallies, and fought like men in deſpair, though they were always at laſt beaten back into the town with conſiderable loſs. In ſhort, the ſiege continued during the whole of this year, in which the greateſt part of the eaſtern city, called the *Camp of Al Mohdi*, was demoliſhed or reduced to aſhes. The citizens, as well

Bagdad.

well as the garrison, were reduced to the last extremity by the length and violence of the siege.

In the beginning of the 198th year of the Hegira, Al Amin finding himself deserted by his troops, as well as by the principal men of Bagdad, who had kept a private correspondence with Thaher, was obliged to retire to the old town on the west bank of the Tigris. He did not, however, take this step, before the inhabitants of the new town had formally deposed him, and proclaimed his brother Al Mamun khalif. Thaher, receiving advice of this, caused the old town to be immediately invested, planted his engines against it, and at last starved it to a surrender. Al Amin being thus reduced to the necessity of putting himself into the hands of one of the generals, chose to implore the protection of Harthema, whom he judged to be of a more humane disposition than Thaher. Having obtained this, he embarked in a small vessel in order to arrive at that part of the camp where Harthema was posted; but Thaher being informed of his design, which, if put in execution, he thought would eclipse the glory he had acquired, laid an ambush for him, which he had not the good fortune to escape. Upon his arrival in the neighbourhood of Harthema's tent, Thaher's soldiers rushed upon him, drowned all his attendants, and put himself

25 Al Amin murdered.

in prison. Here he was soon after massacred by Thaher's servants, who carried his head in triumph to their master, by whose order it was afterwards exposed to public view in the streets of Bagdad. Thaher afterwards sent it to Al Mamun in Khorasan, together with the ring or seal of the khalifat, the sceptre, and the imperial robe. At the sight of these, Al Mamun fell down on his knees, and returned thanks to God for his success; making the courier who brought them a present of a million of dirhems, in value about L. 100,000 Sterling.

26 Succeeded by Al Mamun.

The same day that Al Amin was assassinated, his brother Al Mamun was proclaimed khalif at Bagdad. He had not been long seated on the throne when he was alarmed by rebellions breaking out in different

27 Khorasan dismembered from the empire.

parts of the empire. These, however, were at last happily extinguished; after which, Thaher Ebn Hosein had the government of Khorasan conferred upon him and his descendants with almost absolute and unlimited power. This happened in the 205th year of the Hegira, from which time we may date the dismemberment of that province from the empire of the khalifs.

During the reign of this khalif nothing remarkable happened; only the African Moslems invaded the island of Sicily, where they made themselves masters of several

28 Death of Al Mamun

places. He died of a surfeit in the 218th year of the Hegira, having reigned 20, and lived 48 or 49 years.

On the death of Al Mamun, his brother Al Motasem, by some of the oriental historians surnamed *Billah*, was saluted khalif. He succeeded by virtue of Al Mamun's express nomination of him to the exclusion of his own son Al Abbas and his other brother Al Kasem who had been appointed by Harun Al Rashid. In

29 War between the new khalif Al Motasem and Babec.

the beginning of his reign he was obliged to employ the whole forces of his empire against one Babec, who had been for a considerable time in rebellion in Persia and Persian Irak. This Babec first appeared in the year of the Hegira 201, when he began to take upon him the title of a *prophet*. What his particular doctrine was, is now unknown; but his religion is said to have differed from all others then known in Asia. He gained a great number of proselytes in Aderbijan and the Persian Irak, where he soon grew powerful enough to wage war with the khalif Al Mamun, whose troops he often beat, so that he was now become extremely formidable. The general sent by Al Motasem to reduce him was Haider Ebn Kaus, surnamed *Asshin*, a Turk by nation, who had been brought a slave to the khalif's court, and having been employed in disciplining the Turkish militia there, had acquired the reputation of a great captain. By him Babec was defeated with prodigious slaughter, no fewer than 60,000 men being killed in the first engagement. The next year, being the 220th of the Hegira, he received a still greater overthrow, losing 100,000 men either killed or taken prisoners. By this defeat he was obliged to retire into the Gordyæan mountains; where he fortified himself in such a manner, that Asshin found it impossible to reduce him till the year of the Hegira 222. This commander having reduced with invincible patience all Babec's castles one after another, the impostor was obliged to shut himself up in a strong fortress called *Casbabad*, which was now his last resource. Here he defended himself with great bravery for several months; but at last finding he should be obliged to surrender, he made his escape into a neighbouring wood, from whence he soon after came to Asshin, upon that general's promising him pardon. But Asshin no sooner had him in his power, than he first caused his hands and feet, and afterwards his head, to be cut off. Babec had supported himself against the power of the khalifs for upwards of 20 years, during which time he had cruelly massacred 250,000 people; it being his custom to spare neither man, woman, nor child, of the Mahometans or their allies. Amongst the prisoners taken at Casbabad there was one Nud, who had been one of Babec's executioners, and who owned that in obedience to his master's commands he had destroyed 20,000 Moslems with his own hands; to which he added, that vast numbers had also been executed by his companions, but that of these he could give no precise account.

30 Babec defeated.

31 Taken prisoner and put to death

32 He destroyed vast numbers of Moslems.

In the 223d year of the Hegira, the Greek emperor Theophilus invaded the khalif's territories, where he behaved with the greatest cruelty, and by destroying Sozopetra the place of Al Motasem's nativity, notwithstanding his earnest intreaties to the contrary, occasioned the terrible destruction of *Amorium* mentioned under that article. The rest of this khalif's reign is remarkable for nothing but the execution of Asshin, who was accused of holding correspondence with the khalif's enemies. After his death a great number of idols were found in his house, which were immediately burned, as also several books said to contain impious and detestable opinions.

33 Death of Al Motasem.

In the 227th year of the Hegira died the khalif Al Motasem, in the 48th or 49th year of his age. He reigned eight years eight months and eight days, was born in the eighth month of the year, fought eight battles had 8000 slaves, and had 8,000,000 dinars and 80,000 dirhems in his treasury at his death, whence the oriental historians give him the name of *Al Mothamen*, or the *Octonary*. He is said to have been so robust, that he once carried a burden of 1000 pounds weight several paces. As the people of Bagdad disturbed him with

Badgad.

34 He built the city of Sarra Manray.

frequent revolts and commotions, he took the resolution to abandon that city, and build another for his own residence. The new city he built was first called *Samarra*, and afterwards *Sarra Manray*, and stood in the Arabian Irak. He was attached to the opinion of the Motazalites, who maintain the creation of the Koran; and both he and his predecessor cruelly persecuted those who believed it to be eternal.

35 His successors Al Wathek and Al Motowakkel.

Al Motasem was succeeded by Al Wathek Billah, who the following year, being the 228th of the Hegira, invaded and conquered Sicily. Nothing remarkable happened during the rest of his reign; he died in the 232d year of the Hegira, and was succeeded by his brother Al Motawakkel.

56 Monstrous cruelty of Al Motowakkel.

The new khalif began his reign with an act of the greatest cruelty. The late khalif's vizir having treated Al Motawakkel ill in his brother's lifetime, and opposed his election to the khalifat, was on that account now sent to prison. Here the khalif ordered him to be kept awake for several days and nights together: after this, being suffered to fall asleep, he slept a whole day and night; and after he awoke was thrown into an iron furnace lined with spikes or nails heated red hot, where he was miserably burnt to death. During this reign nothing remarkable happened, except wars with the Greeks, which were carried on with various success. In the year 859 too, being the 245th of the Hegira, violent earthquakes happened in many provinces of the Moslem dominions; and the springs at Mecca failed to such a degree, that the celebrated well Zemzem was almost dried up, and the water sold for 100 dirhems a bottle.

37 He is assassinated.

In the 247th year of the Hegira, the khalif was assassinated at the instance of his son Al Montaser; who succeeded him, and died in six months after. He was succeeded by Al Mostain, who in the year of the Hegira 252 was forced to abdicate the throne by his brother Al Motazz, who afterwards caused him to be privately murdered. He did not long enjoy the dignity of which he had so iniquitously possessed himself; being deposed by the Turkish militia (who now began to set up and depose khalifs as they pleased) in the 255th year of the Hegira. After his deposition, he was sent under an escort from Sarra Manray to Bagdad, where he died of thirst or hunger, after a reign of four years and about seven months.

38 Hard fate of Al Motazz a succeeding khalif.

The fate of this khalif was peculiarly hard: the Turkish troops had mutinied for their pay; and Al Motazz, not having money to satisfy their demands, applied to his mother named *Kabiha* for 50,000 dinars. This she refused, telling him that she had no money at all, although it afterwards appeared that she was possessed of immense treasures. After his deposition, however, she was obliged to discover them, and even deposite them in the hands of the new khalif Al Mokhtadi. They consisted of 1,000,000 dinars, a bushel of emeralds, and another of pearls, and three pounds and three quarters of rubies of the colour of fire.

Al Mokhtadi, the new khalif, was the son of one of Al Wathek's concubines named *Korb*, or *Karb*, who is by some supposed to have been a Christian.

39 Irruption of the Zenjians in the reign of Al-Mokhtadi.

The beginning of his reign is remarkable for the irruption of the Zenjians, a people of Nubia, Ethiopia, and the country of Caffres, into Arabia, where they penetrated into the neighbourhood of Basra and Cufa. The chief of this gang of robbers, who according to some of the Arab historians, differed but little from wild beasts, was Ali Ebn Mohammed Ebn Abdalrahman, who falsely gave himself out to be of the family of Ali Ebn Abu Taleb. This made such an impression upon the Shiites in those parts, that they flocked to him in great numbers; which enabled him to seize upon the cities of Basra and Ramla, and even to pass the Tigris at the head of a formidable army. He then took the title of *Prince of the Zenjians*, in order to ingratiate himself with those barbarians, of whom his army was principally composed.

Bagdad.

In the 256th year of the Hegira, Al Mokhtadi was barbarously murdered by the Turks who had raised him to the throne, and was succeeded by Al Montamed the son of Al Motawakkel. This year the prince of the Zenjians, Ali, or as he is also called, *Al Habib*, made incursions to the very gates of Bagdad, doing prodigious mischief wherever he passed. The khalif therefore sent against him one Jolan with a considerable army; he was overthrown, however, with very great slaughter by the Zenjian, who made himself master of 24 of the khalif's largest ships in the bay of Basra, put a vast number of the inhabitants of Obolla to the sword, and seized upon the town. Not content with this, he set fire to it, and soon reduced it to ashes, the houses mostly consisting of the wood of a certain plane-tree called by the Arabians *Saj*. From thence he marched to Abadan, which likewise surrendered to him. Here he found an immense treasure, which enabled him to possess him of the whole district of Ahwaz. In short, his forces being now increased to 80,000 strong, most of the adjacent territories, and even the khalif's court itself, were struck with terror.

30 Al Habib's success.

In the 257th year of the Hegira, Al Habib continued victorious, defeated several armies sent against him by the khalif, reduced the city of Basrah, and put 20,000 of the inhabitants to the sword. The following year, the khalif, supported by his brother Al Mowaffek, had formed a design of circumscribing the power of the Turkish soldiery, who had for some time given law to the khalifs themselves. But this year the Zenjians made so rapid a progress in Persia, Arabia, and Irak, that he was obliged to suspend the execution of his design, and even to employ the Turkish troops to assist his brother Al Mowaffek in opposing these robbers. The first of the khalif's generals who encountered Al Habib this year, was defeated in several engagements, and had his army at last entirely destroyed. After this Al Mowaffek and another general named *Mosleh* advanced against him. In the first engagement Mosleh being killed by an arrow, the khalif's troops retired; but Al Mowaffek put them afterwards in such a posture of defence, that the enemy durst not renew the attack. Several other sharp encounters happened this year, in which neither party gained great advantage; but, at last, some contagious distempers breaking out in Al Mowaffek's army, he was obliged to conclude a truce, and retire to Waset to refresh his troops.

In the 259th year of the Hegira, commencing Nov. 7th, 872, the war between the khalif and Al Habib still continued. Al Mowaffek, upon his arrival at Bagdad, sent Mahammed, surnamed *Al Mowalled*, with a powerful army to act against the Zenjians: but he could not hinder them from ravaging the province of Ahwaz,

Bagdad.

cutting off about 50,000 of the khalif's subjects, and dismantling the city of Ahwas; and notwithstanding the utmost efforts of all the khalif's generals, no considerable advantages could be gained either this or the following year.

41 Rebellion in Fars, Ahwas, and Basra.

In the 261st year of the Hegira, beginning October 16th, 874, Mohammed Ebn Wasel, who had killed the khalif's governor of Fars, and afterwards made himself master of that province, had several engagements with Al Habib, but with what success is not known. The khalif, having been apprized of the state of affairs on that side, annexed the government of Fars, Ahwas, and Basra, to the prefecture he had given to Musa Ebn Boga, whom he looked upon as one of the best generals he had. Musa, soon after his nomination to that post, sent Abdalrahman Ebn Mosleh as his deputy to Ahwas, giving him as a colleague and assistant one Tisam, a Turk. Mohammed Ebn Wasel, however, refusing to obey the orders of Abdalrahman and Tisam; a fierce conflict ensued, in which the latter were defeated, and Abdalrahman taken prisoner. After this victory, Mohammed advanced against Musa Ebn Boga himself; but that general, finding he could not take possession of his new government without a vast effusion of blood, recalled the deputies from their provinces, and made the best of his way to Sarra Manray. After this, Yakub Ebn Al Leit, having taken Khorasan from the descendants of Thaher, attacked and defeated Mohammed Ebn Wasel, seizing on his palace, where he found a sum of money amounting to 40,000,000 dirhems.

42 Rebels defeated, but cannot be reduced.

The next year Yakub Ebn Al Leit being grown formidable by the acquisition of Ahwas and a considerable portion of Fars, or at least the Persian Irak, declared war against the khalif. Against him Al Motamed dispatched Al Mowaffek; who having defeated him with prodigious slaughter, plundered his camp, and pursued him into Khorasan; where meeting with no opposition, he entered Nisabur, and released Mahomet the Thaherian, whom Yakub had detained in prison three years. As for Yakub himself, he made his escape with great difficulty, tho' he and his family continued several years in possession of many of the conquests he had made. This war with Yakub proved a seasonable diversion in favour of Al Habib, who this year defeated all the forces sent against him, and ravaged the district of Waset.

43 Al Habib still victorious.

The following year, being the 263d of the Hegira, beginning September 24th, 876, the khalif's forces, under the command of Ahmed Ebn Lebuna, gained two considerable advantages over Al Habib; but being at last drawn into an ambuscade, they were almost totally destroyed, their general himself making his escape with the utmost difficulty; nor were the khalif's forces able, during the course of the next year, to make the least impression upon these rebels.

44 Rebellion in Egypt which cannot be suppressed.

In the 265th year of the Hegira, beginning September 3d, 878, Ahmed Ebn Tolun rebelled against the khalif, and set up for himself in Egypt. Having assembled a considerable force, he marched to Antioch, and besieged Sima the governor of Aleppo, and all the provinces known among the Arabs, by the name of *Al Awasem* in that city. As the besieged found that he was resolved to carry the place by assault, they thought fit, after a short defence, to submit, and to put Sima into his hands. Ahmed no sooner had that officer in his power, than he caused him to be beheaded; after which he advanced to Aleppo, the gates of which were immediately opened unto him. Soon after, he reduced Damascus, Hems, Hamath, Kinnisrin, and Al Rakka, situated upon the eastern bank of the Euphrates. This rebellion so exasperated Al Motamed, that he caused Ahmed to be publicly cursed in all the mosques belonging to Bagdad and Irak; and Ahmed on his part ordered the same malediction to be thundered out against the khalif in all the mosques within his jurisdiction. This year also a detachment of Al Habib's troops penetrated into Irak, and made themselves masters of four of the khalif's ships laden with corn; then they advanced to Al Nomanic, laid the greatest part of it in ashes, and carried off with them several of the inhabitants prisoners. After this they possessed themselves of Jarjaraya, where they found many prisoners more, and destroyed all the adjacent territory with fire and sword. This year there were four independent powers in the Moslem dominions, besides the house of Ommiyah in Spain; viz. The African Moslems, or Aglabites, who had for a long time acted independently; Ahmed in Syria and Egypt; Al Leit in Khorasan; and Al Habib in Arabia and Irak.

45 Four independent powers in the khalif's nominal dominions.

In the 266th year of the Hegira, beginning August 23d, 879, Al Habib reduced Ramhormoz, burnt the stately mosque there to the ground, put a vast number of the inhabitans to the sword, and carried away great numbers, as well as a vast quantity of spoil.— This was his last successful campaign; for the year following, Al Mowaffek, attended by his son Abul Abbas, having attacked him with a body of 10,000 horse, and a few infantry, notwithstanding the vast disparity of numbers (Al Habib's army amounting to 100,000 men), defeated him in several battles, recovered most of the towns he had taken, together with an immense quantity of spoil, and released 5000 women that had been thrown into prison by these barbarians. After these victories, Al Mowaffek took post before the city of Al Mabiya', built by Al Habib, and the place of his residence, burnt all the ships in the harbour; thoroughly pillaged the town; and then entirely dismantled it. After the reduction of this place, in which he found immense treasures, Al Mowaffek pursued the flying Zenjians, put several of their chiefs to the sword, and advanced to Al Mokhtara, a city built by Al Habib. As the place was strongly fortified, and Al Habib was posted in its neighbourhood, with an army, according to Abu Jaafer Al Tabari, of 300,000 men, Al Mowaffek perceived that the reduction of it would be a matter of some difficulty. He therefore built a fortress opposite to it, where he erected a mosque, and coined money. The new city, from its founder, was called by the Arabs *Al Mowaffekkia*, and soon rendered considerable by the settlement of several wealthy merchants there. The city of Al Mokhtara being reduced to great straits was at last taken by storm, and given up to be plundered by the khalif's troops; after which Al Mowaffek defeated the numerous forces of Al Habib in such a manner, that they could no more be rallied during that campaign.

46 Al Habib's bad success and death.

The following year, being the 268th of the Hegira, Al Mowaffek penetrated again into Al Mabiya', and demolished the fortifications which had been raised since its former reduction, though the rebels disputed every

every inch of ground. Next year he again attacked Al Habib with great bravery; and would have entirely defeated him, had he not been wounded in the breast with an arrow, which obliged him to sound a retreat. However, as soon as he was cured of his wound, Al Mowaffek advanced a third time to Al Mabiya', made himself master of that metropolis, threw down the walls that had been raised, put many of the inhabitants to the sword, and carried a vast number of them into captivity.

The 27th year of the Hegira, commencing July 11th, 883, proved fatal to the rebel Al Habib. Al Mowaffek made himself a fourth time master of Al Mabiya', burnt all Habib's palace, seized upon his family, and sent them to Sarra Manray. As for the usurper himself, he had the good fortune to escape at this time; but being closely pursued by Al Mowaffek into the province of Ahwas, where the shattered remains of his forces were entirely defeated, he at last fell into the hands of the victor, who ordered his head to be cut off, and carried through a great part of that region which he had so long disturbed. By this complete victory Al Mowaffek obtained the title of *Al Nasir Lidmilbah*, that is, *the protector of Mahometanism*. This year also died Ahmed Ebn Tolun, who had seized upon Egypt and Syria, as we have already observed; and was succeeded by his son *Khamarawiyah*.

47 Success of the sultan of Egypt.

The next year, a bloody engagement happened between the khalif's forces commanded by Al Mowaffek's son, and those of Khamarawiyah, who had made an irruption into the khalif's territories. The battle was fought between Al Ramla and Damascus. In the beginning, Khamarawiyah found himself so hard pressed, that his men were obliged to give way; upon which, taking for granted that all was lost, he fled with great precipitation, even to the borders of Egypt; but, in the mean time, his troops being ignorant of the flight of their general, returned to the charge, and gained a complete victory. After this, Khamarawiyah, by his just and mild administration, so gained the affections of his subjects, that the khalif found it impossible to gain the least advantage over him. In the 276th year of the Hegira, he overthrew one of the khalif's generals named Abul Saj, at Al Bathnia near the city of Damascus; after which he advanced to Al Rakka on the Euphrates, and made himself master of that place. Having annexed several large provinces to his former dominions, and left some of his friends in whom he could confide to govern them, he then returned into Egypt, the principal part of his empire, which now extended from the Euphrates to the borders of Nubia and Ethiopia.

48 Al Mowaffek dies.

The following year, being the 278th of the Hegira, was remarkable for the death of Al Mowaffek. He died of the elephantiasis or leprosy; and while in his last illness, could not help observing, that of 100,000 men whom he commanded, there was not one so miserable as himself. This year is also remarkable for the first disturbances raised in the Moslem empire by the Karmatians.

49 Origin of the Karmatians.

The origin of this sect is not certainly known; but the most common opinion is, that a poor fellow, by some called *Karmata*, came from Khuzestan to the villages near Cufa, and there pretended great sanctity and strictness of life, and that God had enjoined him to pray 50 times a-day; pretended also to invite people to the obedience of a certain Imam of the family of Mahomet; and this way of life he continued till he had made a very great party, out of whom he chose twelve as his apostles to govern the rest, and to propagate his doctrines. He also assumed the title of *prince*, and obliged every one of his earlier followers to pay him a dinar a-year. But Al Haidam, the governor of that province, finding men neglected their work, and their husbandry in particular, to say those 50 prayers a-day, seized the fellow, and having put him in prison, swore that he should die. This being overheard by a girl belonging to the governor, she, out of compassion, took the key of the dungeon at night from under her master's head, released the man, and restored the key to its place while her master slept. The next morning the governor found his prisoner gone; and the accident being publicly known, raised great admiration; Karmata's adherents giving out that God had taken him into heaven. After this he appeared in another province, and declared to a great number of people he got about him, that it was not in the power of any person to do him hurt; notwithstanding which, his courage failing him, he retired into Syria, and was never heard of any more. After his disappearance, the sect continued and increased; his disciples pretending that their master had manifested himself to be a true prophet, and had left them a new law, wherein he had changed the ceremonies and form of prayer used by the Moslems, &c. From this year, 278, these sectaries gave almost continual disturbance to the khalifs and their subjects, committing great disorders in Chaldæa, Arabia, and Mesopotamia, and at length established a considerable principality.

50 Sultan of Egypt's daughter married to the khalif Al Motaded.

In the 279th year of the Hegira died the khalif Al Motamed; and was succeeded by Al Motaded, son to Al Mowaffek. The first year of his reign, Al Motaded demanded in marriage the daughter of Khamarawiyah, sultan, or khalif, in Egypt; which was agreed to by him with the utmost joy, and their nuptials were solemnized with great pomp in the 282d year of the Hegira. He carried on a war with the Karmatians; but very unsuccessfully, his forces being defeated with great slaughter, and his general Al Abbas taken prisoner. This khalif also granted to Harun, son to Khamarawiyah, the perpetual prefecture of Awasam and Kinnisrin, which he annexed to that of Egypt and Syria, upon condition that he paid him an annual tribute of 45,000 dinars. He died in the year of the Hegira 289, and was succeeded by his son Al Moctasi.

51 Egypt, &c. recovered by the khalif Al Moctasi.

This khalif proved a warlike and successful prince. He gained several advantages over the Karmatians, but was not able to reduce them. The Turks, however, having invaded the province of Mawarnalnahr, were defeated with great slaughter; after which, Al Moctasi carried on a successful war against the Greeks, from whom he took Seleucia. After this he invaded Syria and Egypt, which provinces he recovered from the house of Ahmed Ebn Tolun.

52 Distressed state of the khalifs after his death.

The reduction of Egypt happened in the 292d year of the Hegira, after which the war was renewed with success against the Greeks and Karmatians. The khalif died in the 295th year of the Hegira, after a reign of about six years and a half. He was the last of the khalifs who made any figure by their warlike exploits. His successors Al Moktader, Al Kaher, and Al Radi,

were

Bagdad. were so distressed by the Karmatians and numberless usurpers who were every day starting up, that by the 325th year of the Hegira, they had nothing left but the city of Bagdad. In the 324th year of the Hegira, commencing November 30th, 935, the khalif Al Radi, finding himself distressed on all sides by usurpers, and having a vizir of no capacity, instituted a new office superior to that of vizir, which he intitled *Emir Al Omra*, or *Commandant of Commandants*. This great officer was trusted with the management of all military affairs, and had the entire management of the finances in a much more absolute and unlimited manner than any of the khalif's vizirs ever had. Nay, he officiated for the khalif in the great mosque at Bagdad, and had his name mentioned in the public prayers throughout the kingdom. In short, the khalif was so much under the power of this officer, that he could not apply a single dinar to his own use without the leave of the Emir Al Omra. In the year 325, the Moslem empire, once so great and powerful, was shared among the following usurpers:

53 New office of Emir Al Omra instituted by Al Radi.

54 Division of the Moslem empire in the 325th year of the Hegira.

The cities of Waset, Basra, and Cufa, with the rest of the Arabian Irak, were considered as the property of the Emir Al Omra, though they had been in the beginning of the year seized upon by a rebel called *Al Baridi*, who could not be driven out of them.

The country of Fars, Farsestan, or *Persia*, properly so called, was possessed by Amado'ddawla Ali Ebn Buiya, who resided in the city of Shiraz.

Part of the tract denominated *Al Jebal*, together with Persian Irak, which is the mountainous part of Persia, and the country of the ancient Parthians obeyed Rucno'ddawla, the brother of Amado'ddawla, who resided at Ispahan. The other part of that country was possessed by Washmakin the Deylamite.

Diyar Rabia, Diyar Becr, Diyar Modar, and the city of Al Mawsel, or Mosul, acknowledged for their sovereign a race of princes called *Hamdanites*.

Egypt and Syria no longer obeyed the khalifs, but Mahomet Ebn Taj, who had formerly been appointed governor of these provinces.

Africa and Spain had long been independent.

Cicily and Crete were governed by princes of their own.

The provinces of Khorasan and Marawalnahr were under the dominion of Al Nasr Ebn Ahmed, of the dynasty of the Sammarians.

The provinces of Tabrestan, Jorjan or Georgiana, and Mazanderan, had kings of the first dynasty of the Deylamites.

The province of Kerman was occupied by Abu Ali Mahomet Ebn Eylia Al Sammani, who had made himself master of it a short time before. And,

Lastly, the provinces of Yamama and Bahrein, including the district of Hajr, were in the possession of Abu Thaher the Karmatian.

Thus the khalifs were deprived of all their dominions, and reduced to the rank of sovereign pontiffs; in which light, though they continued for some time to be regarded by the neighbouring princes, yet their power never arrived to any height. In this low state the khalifs continued till the year of the Hegira 656, commencing January 8th, 1258. This year was rendered remarkable by the taking of Bagdad by Hulaku the Mogul or Tartar; who likewise abolished the khalifat, putting the reigning khalif Al Mostasem Billah to a most cruel death. These diabolical conquerors, after they had taken the city, massacred, according to custom a vast number of the inhabitants; and after they had plundered it, set it on fire. The spoil they took from thence was prodigiously great, Bagdad being then looked upon as the first city in the world.

55 Bagdad taken by the Tartars.

56 History of the city since that time.

Bagdad remained in the hands of the Tartars or Moguls to the year of the Hegira 795, of Christ 1392, when it was taken by Tamerlane from Sultan Ahmed Ebn Weis; who being incapable of making head against Tamerlane's numerous forces, found himself obliged to send all his baggage over the Tigris, and abandon his capital to the conqueror. He was, however, hotly pursued by his enemy's detachments to the plain of Karbella, where several skirmishes happened, and a considerable number of men were lost on both sides. Notwithstanding this disaster, he found means to escape the fury of his pursuers, took refuge in the territories of the Greek emperor, and afterwards repossessed himself of the city of Bagdad. There he remained till the year of the Hegira 803, when the city was taken a second time by Tamerlane; who nevertheless restored it to him, and he continued sovereign of the place till driven from thence by Miram Shah. Still, however, he found means to return; but in the 815th year of the Hegira was finally expelled by Kara Yusef the Turkman. The descendants of Kara Yusef continued masters of Bagdad till the year of the Hegira 875, of Christ 1470, when they were driven out by Usun Cassun. The family of this prince continued till the year of the Hegira 914, of our Lord 1508, when Shah Ishmael, surnamed *Sufi* or *Sofi*, the first prince of the royal family reigning in Iran or Persia, till the dethroning of the late Shah Hosein, made himself master of it. From that time to this Bagdad has continued to be a bone of contention between the Turks and Persians. It was taken by Soliman surnamed the *magnificent*, and retaken by Shah Abbas the great, king of Persia: but being at last besieged by Amruth or Morad IV. with a formidable army, it was finally obliged to surrender to him in the year 1638; since which time the Persians have never been able to make themselves masters of it for any length of time.

57 Its present state.

The city is large and populous; and the advantage of the Tigris is so considerable, with regard to commerce, that although the climate is excessive hot, and in other respects far from being agreeable, yet the number of its inhabitants is computed at 300,000; but before the plague broke out there, they were supposed to be four times that number. It is governed by a bashaw, whose authority extends as far as Courdistan. The revenues would be immense was the government mild; but instead thereof, oppression rules here with the most despotic sway. The bashaw is continually extorting money from the poor inhabitants, and none suffer more than the unfortunate Jews and Christians, many of whom are put to the most cruel tortures in order to force their property from them. This series of tyranny and oppression has almost entirely drove them out of the city, in consequence of which the trade must suffer very considerably, they being generally the principal merchants in the place. In the months of June, July, and August, the weather is so extremely hot, as to oblige the inhabitants to live for

Bagdad. these months in subterraneous apartments, which are arched over, to admit the freer circulation of the air. The houses are generally large, built of brick and cement, and are arched over; many of the windows are made of elegant Venetian glass; the ceilings are mostly ornamented with a kind of chequered work, which has generally a noble appearance; most of the houses have a court-yard before them, in the middle of which is a little plantation of orange trees, &c. that has a very pleasing effect. The soil, which would produce not only every conveniency in life, but almost every luxury, is through the natural indolence of the Turks, and the many faults in the government of the country, in a great measure uncultivated and neglected. The revenues are computed at 125 lacks of piastres, or 1,562,500l. sterling; but a quarter part of this is not collected, owing to the slothfulness of the Turks, who suffer the Arabs to plunder them of the remainder. This in some measure accounts for the cruelties and extortions that are continually practised here. As the bashaw lives in all the splendor of a sovereign prince, and maintains a very large army, he could not be able to defray his expences, was he not to have recourse to oppression and injustice; and he, by his extensive power, acting almost independent of the Porte, only acknowledging it to bring in a balance from thence yearly in his favour.

The bazars or markets here are large and extensive; being covered over with arches built of masonry, and divided into different streets, filled with shops of all kinds of merchandize, to the number of 12,000. Every thing a person can have occasion for may be had there. The number of houses in the city is computed at near 80,000; and each house and shop pay an annual tribute to the bashaw, which is calculated to produce the sum of 300,000l. sterling. Besides these immense revenues that are collected, the bashaw pretends, that by repairs on the fortifications 30,000l. or 40,000l. are annually expended, when not so many hundreds are taken out of his coffers for that purpose. Likewise clearing the river and mending the bridge become a charge greater than their income, and probably not the value of an English shilling is expended. —To support the expence of the seraglio, their clothes, caparisons of their horses, and every outward pomp, the amount is considerable.

On the north side of the town stands the citadel, which commands the river; and consists of curtains and bastions, on which some very long cannon are mounted, with two mortars in each bastion, placed no other beds than the ground, and in very bad condition. The carriages of the guns are likewise so unwieldy, and in such a shattered condition, that from their appearances they would not support one firing, but would be shaken in pieces. Their elevations were from 30 to 40 degrees, but they had no quoins to level them. There are besides, a number of small towers, and loop-holes for musquetry, placed at certain distances, all well encompassed by a ditch of 27 feet deep, which can be filled at any time by the waters of the Tigris. The citadel is so close to the houses, that it might be easily taken if possession was once gained of the town; but an attack made towards the land would not probably be succesful, as sluices might with the greatest facility be cut into the ditch, and so overflow the country for miles round; but it is said an advantageous attack might be made from the water.

The city, which is fortified by lofty thick walls of brick covered with earth, and strengthened by great towers much resembling cavalier bastions, the whole being surrounded by a deep ditch, is in the form of an irregular square; but the walls in many places are broken down, occasioned by the disputes which happened on the death of Abdulla Basha a few years ago, when two competitors arose in Bagdad for the bashawic, who fought several times in the town and citadel, and laid great part of it in ruins. In the interim, the governor of Mussool and Nineveh being appointed Bashaw by the Porte, came hither with a considerable army, and took possession of the sovereignty, vanquishing his two opponents. Opposite to the city, on the other side of the river, are very extensive suburbs, from whence shells might be thrown into the town, which would have a dreadful effect on a place so closely built. There is a communication beween the city and suburbs by a bridge of boats; the only kind of bridge which that river will admit of, as it is broad and deep, and in its ordinary course very rapid. At certain seasons it swells to a prodigious height, and overflowing the country occasions many morasses on that side opposite to the city. Among these are several towns and villages, whose inhabitants are said to be the ancient Chaldeans: they are of a particular religion, which they pretend is that of Seth. The inhabitants of this city are composed chiefly of Persians, Armenians, Turks, Arabs, and Jews, which last act in the capacity of schroffs, or bankers, to the merchants. The Jews, notwithstanding the severe treatment they meet with from the government, are induced to live here from a reverence to the prophet Ezekiel, whose mausoleum they pretend is a day's journey from the city. Besides the Jews who reside here, there are many that come every year out of devotion to visit the prophet's tomb. There are also two European gentlemen, a Venetian and a Frenchman, with five Romish priests, who are Frenchmen and Italians. Two chapels are permitted for those of the Romish and Greek persuasions; at the former the five priests officiate. In the city are several large beautiful mosques, but into which Christians are never suffered to enter, if known to be such, for fear it should defile them. The Mahometan women are very richly dressed, wearing bracelets on their arms and jewels in their ears: the Arabian women have the partition between their nostrils bored, wherein they wear rings.

There are also a number of antique buildings. At the distance of about ten miles stand the ruins of an ancient tower called the *Tower of Nimrod*. Whether this tower was at first of a square or round form is now difficult to determine; though the former is most probable, because all the remaining bricks are placed square, and not in the least circular. The bricks are all twelve inches square and four and an half thick. The cement is of mud or slime, mixed with broken reed, as we mix hair with mortar; which slime might either have been had from one of the great rivers, or taken out of one of the swamps in the plain, with which the country hereabout very much abounds. The height of the ruin is 126 feet; the diameter of the largest

largest and middle part about 100 feet. It would appear to be solid to the centre; yet near the top there is a regular opening of an oval form. The circumference of that part of the tower which remains, and is above the rubbish, is about 300 feet; but probably, could the foundation be come at, it would be found of far greater extent. The present Turks, Jews, and Arabians, are fond of believing this to be the identical ruin of the ancient tower of Babel, for which they assign a variety of reasons; but all so void of the appearance of truth, that to set about confuting them would be losing time in trifles. It appears to have been a beacon or watch-tower, to give notice of the approach of an enemy: or perhaps was used as an observatory to inspect the various motions of the heavenly bodies; which science was so much cultivated among the ancient inhabitants of this country, that even the Grecians, though desirous of being esteemed the inventors of all arts and sciences, could never deny the Babylonians the honour of having laid the foundations of astronomy.

BAGGAGE, in military affairs, denotes the clothes, tents, utensils of divers sorts, provisions, and other necessaries belonging to the army.

Before a march, the waggons with the baggage are marshalled according to the rank which the several regiments bear in the army; being sometimes ordered to follow the respective columns of the army, sometimes to follow the artillery, and sometimes to form a column by themselves. The general's baggage marches first; and each waggon has a flag, showing the regiment to which it belongs.

Packing up the BAGGAGE, *vasa colligere*, was a term among the Romans, for preparing to go to war, or to be ready for an expedition.

The Romans distinguished two sorts of baggage; a *greater* and *less*. The lesser was carried by the soldier on his back, and called *sarcina;* consisting of the things most necessary to life, and which he could not do without. Hence *colligere sarcinas*, packing up the baggage, is used for decamping, *castra movere*. The greater and heavier was carried on horses and vehicles, and called *onera*. Hence *onera vehiculorum, sarcinæ hominum*. The baggage-horses were denominated *sagmentarii equi*.

The Roman soldiers in their marches were heavy loaden; insomuch, that they were called by way of jest *muli mariani*, and *ærumnæ*. They had four sorts of luggage, which they never went without, *viz.* corn, or *buccellatum*, utensils, valli, and arms. Cicero observes, that they used to carry with them above half a month's provisions; and we have instances in Livy, where they carried provisions for a whole month. Their utensils comprehended those proper for gathering fuel, dressing their meat, and even for fortification or intrenchment; and what is more, a chain for binding captives. For arms, the foot carried a spear, shield, saw, basket, rutrum, hatchet, lorum, falx, &c. Also stakes or pales, *valli*, for the sudden fortifying a camp; sometimes seven or even twelve of these pales were carried by each man, though generally, as Polybius tells us, only three or four. On the Trajan column we see soldiers represented with this fardle of corn, utensils, pales, &c. gathered into a bundle and laid on their shoulders. Thus inured to labour, they grew strong, and able to undergo any fatigue in battle; the greatest heat of which never tired them, or put them out of breath. In after-times, when discipline grew slack, this luggage was thrown on carriages and porters shoulders.

The Macedonians were not less inured to hardship than the Romans; when Philip first formed an army, he forbid all use of carriages; yet, with all their load, they would march, in a summer's day, 20 miles in military rank.

BAGLANA, or BUGLANA, a province of the kingdom of Dekkan in the Mogul's empire. It is bounded on the north and east by Guzerat and Ballagat; and on the south and west by that part of Viziapur called *Konkan*, belonging to the Marattas. It ends in a point at the sea-coast between Daman and Balsora, and is the least province in the kingdom. The Portuguese territories begin in this province at the port Daman, 21 leagues south of Surat; and run along the coast by Bassaim, Bombay, and Chawl, to Dabul, almonst 50 leagues to the north of Goa.

BAGLIVI (George), a most illustrious physician of Italy, was a native of Apulia, and born about the year 1668. He studied at Padua, where he became doctor; and then went to Rome, where he was chosen professor of anatomy. He was a man of most uncommon force of understanding, of which he gave ample proofs in many curious and accurate productions, philosophical as well as medicinal. He died at Rome 1706, in the flower of his age, and when he was no more than 38. A collection of his works were printed first in 1710, quarto; and have since been reprinted, in the same size, at various places. His *Praxis Medica*, and *De Fibra Matricis*, are the principal pieces. He wrote a Dissertation upon the Anatomy, Bite, and Effects, of the Tarantula, which is the production of his country; and gave a particular account of the earthquake at Rome and the adjacent cities in 1703. His works are all in Latin.

BAGNAGAR, a town of Asia, in the dominions of the Great Mogul, and capital of the kingdom of Golconda in the peninsula on this side the Ganges. The inhabitants within the town are the better sort; the merchants and meaner people inhabiting the suburbs, which is three miles long. It is chiefly remarkable for a magnificent reservoir of water, surrounded with a colonnade supported by arches. It is seated on the river Newa, in E. Long. 96. 0. N. Lat. 15. 30.

BAGNARA, a sea-port town of Italy in the kingdom of Naples, in the farther Calabria, with the title of a duchy. E. Long. 16. 8. N. Lat. 38. 15.

BAGNAREA, a town of Italy in St Peter's patrimony, and in the territory of Orvieta, with a bishop's see. E. Long. 12. 10. N. Lat. 42. 36.

BAGNERES, a town of France in Gascony, and in the county of Bigorre, so called from its mineral waters. It is seated on the river Adour, in E. Long. 0. 12. N. Lat, 43. 3.

BAGNIALACK, a large town of Turkey in Europe, in the province of Bosnia. E. Long. 18. 10. N. Lat. 44. 0.

BAGNIO, an Italian word, signifying *a bath*. We use it for a house with conveniences for bathing, cupping, sweating, and otherwise cleansing the body; and sometimes for worse purposes. In Turkey it is become

come a general name for the prisons where the slaves are inclosed, it being usual in these prisons to have baths.

BAGNOLAS, a town of Lower Languedoc in France. It has a very handsome square, and two fountains which rise in the middle of the town; the waters of which, being received in a bason, are conveyed by a canal out of town, and from thence to the lands about it. E. Long. 4. 43. N. Lat. 44. 10.

BAGNOLIANS, or BAGNOLANSES, in church-history, a sect of heretics, who in reality were Manichees, though they somewhat disguised their errors. They rejected the Old Testament and part of the New; held the world to be eternal; and affirmed that God did not create the soul when he infused it into the body.

BAGOI, among the ancient Persians, were the same with those called by the Latins *spadones, viz.* a species of eunuchs, in whom the canal of the penis was so contorted by a tight vinculum, that they could not emit the semen.

BAG-PIPE, a musical instrument, of the wind kind, chiefly used in Scotland and Ireland. The peculiarity of the bag-pipe, and from which it takes its name, is, that the air which blows it is collected into a leathern bag, from whence it is pressed out by the arm into the pipes. These pipes consist of a bass, and tenor or rather treble; and are different according to the species of the pipe. The bass part is called the *drone*, and the tenor or treble part the *chanter*. In all the species, the bass never varies from its uniform note, and therefore very deservedly gets the name of *drone;* and the compass of the chanter is likewise very limited. There is a considerable difference between the Highland and Lowland bag-pipe of Scotland; the former being blown with the mouth, and the latter with a small bellows: though this difference is not essential, every species of bag-pipe being capable, by a proper construction of the reeds, of producing music either with the mouth or bellows. The following are the species of bag-pipes most commonly known in Britain.

1. The *Irish Pipe*. This is the softest, and in some respects the most melodious of any, so that music-books have been published with directions how to play on it. The chanter, like that of all the rest, has eight holes like the English flute, and is played on by opening and shutting the holes as occasion requires; the bass consists of two short drones, and a long one. The lowest note of the chanter is D on the German flute, being the open note on the counter-string of a violin; the small drone (one of them commonly being stopped up) is tuned in unison with the note above this, and the large one to an octave below; so that a great length is required in order to produce such a low note, on which account the drone hath sometimes two or three turns. The instrument is tuned by lengthening or shortening the drone till it sounds the note desired.

2. The *Highland Bag-Pipe*. This consists of a chanter and two short drones, which sound in unison the lowest note of the chanter except one. This is exceedingly loud, and almost deafening if played in a room; and is therefore mostly used in the fields, for marches, &c. It requires a prodigious blast to sound it; so that those unaccustomed to it cannot imagine how Highland pipers can continue to play for hours together, as they are often known to do. For the same reason, those who use the instrument are obliged either to stand on their feet or walk when they play. This instrument hath but nine notes; its scale, however, hath not yet been reduced to a regular standard by comparing it with that of other instruments, so that we can say nothing about its compass. Those who are best acquainted with it, however, affirm that it plays only the natural notes, without being capable of variation by flats or sharps.

3. The *Scots Lowland Pipe*. This is likewise a very loud instrument, though less so than the former. It is blown with bellows, and hath a bass like the Irish pipe. This species is different from all the rest, as it cannot play the natural notes, but hath F and C sharp. The lowest note of a good bag-pipe of this kind is unison with C sharp on the tenor of a violin tuned concert-pitch; and as it hath but nine notes, the highest is D in alt. From this peculiar construction, the Highland and Lowland bag-pipes play two species of music essentially different from one another, as each of them also is from every other species of music in the world. Hence these two species of bag-pipes deserve notice as curiosities; for the music which they play is accompanied with such peculiar ornaments, or what are intended as such, as neither violin, nor even organ, can imitate, but in a very imperfect manner.

This kind of bag-pipe was formerly very much used in Scotland at weddings and other festivals: being indeed extremely well calculated for playing that peculiar species of Scots music called *reels*. It has been often a matter of surprise how this was possible, as the instrument has only a compass of nine or ten notes at the utmost, and which cannot be varied as in other instruments. In this respect, however, it has a very great compass, and will play an inconceivable variety of tunes. As its notes are naturally so high, there is scarce any one tune but what is naturally transposed by it, so that what would be a flat note on the key proper for the violin, may be a sharp one on the bag-pipe; and though the latter cannot play any flat note, it may nevertheless in this manner play tunes which on other instruments would be flat, to as great perfection as these instruments themselves.

4. *The Small Pipe*. This is remakable for its smallness, the chanter not exceeding eight inches in length; for which reason, the holes are so near each other, that it is with difficulty they can be closed. This hath only eight notes, the lower end of the chanter being commonly stopped. The reason of this is, to prevent the slurring of all the notes, which is unavoidable in the other species; so that in the hands of a bad player they become the most shocking and unintelligible instruments imaginable: but this, by having the lower hole closed, and also by the peculiar way in which the notes are expressed, plays all its tunes in the way called by the Italians *staccato*, and cannot slur at all. It hath no species of music peculiar to itself; and can play nothing which cannot be much better done upon other instruments; though it is surprising what vollubility some performers on this instrument will display, and how much they will overcome the natural disadvantages of it. Some of this species, instead of having drones like the others, have their bass parts consisting of a winding cavity in a kind of

of short case, and are tuned by opening these to a certain degree by means of sliding covers; from which contrivance they are called *shuttle-pipes*.—Besides these, there are a variety of others, called *Italian*, *German*, *Organ*, &c. bag-pipes, which have nothing different in their construction from those above described, nor any good quality to recommend them.

As to the origin of bag-pipe music, some are of opinion that it is to be derived from the Danes; but Mr Pennant thinks differently, and gives the following reasons for deriving it ftom Italy.

Voyage to the Hebrides, p. 302.

" Neither of these instruments (the Highland and Lowland bag-pipes above described) were the invention of the Danes, or, as is commonly supposed, of any of the northern nations; for their ancient writers prove them to have been animated by the *clangor tubarum*. Notwithstanding they have had their foeck-pipe long amongst them, as their old songs prove, yet we cannot allow them the honour of inventing this melodious instrument; but must assert, that they borrowed it from the invaded Caledonians. We must still go farther, and deprive even that ancient race of the credit; and derive its origin from the mild climate of Italy, perhaps from Greece.

" There is now in Rome a most beautiful bas relievo, a Grecian sculpture of the highest antiquity, of a bag-piper playing on his instrument, exactly like a modern Highlander. The Greeks had their Ασκαυλης, or instrument, composed of a pipe and blown-up skin: the Romans in all probability borrowed it from them, and introduced it among their swains, who still use it under the names of *piva* and *cornu-musa*.

" That master of music, Nero, used one; and had not the empire been so suddenly deprived of that great artist, he would (as he graciously declared his intention, have treated the people with a concert, and, among other curious instruments, would have introduced the *utricularius* or bag-pipe. Nero perished; but the figure of the instrument is preserved on one of his coins, but highly improved by that great master: it has the bag and two of the vulgar pipes; but was blown with a bellows like an organ, and had on one side a row of nine unequal pipes resembling the syrinx of the god Pan. The bag-pipe, in the unimproved state, is also represented in an ancient sculpture; and appears to have had two long pipes or drones, and a single short pipe for the fingers. Tradition says, that the kind played on by the mouth was introduced by the Danes: as theirs was wind-music, we will admit that they might have made improvement; but more we cannot allow: they were skilled in the use of the trumpet; the Highlanders in the piohb, or bag-pipe,

Non tuba in usu illis, conjecta at tibia in utrum
*Dat belli signum, et martem vocat horrida in arma**."

* *Melvini* Topogr. Scotiæ.

The bag-pipe appears to have been an instrument of great antiquity in Ireland, though it is uncertain whence they derived it. Mr Pennant, by means of an antique found at Richborough in Kent, has determined that the bag-pipe was introduced at a very early period into Britain; whence it is probable that both Irish and Danes might borrow the instrument from the Caledonians, with whom they had such frequent intercourse. Aristides Quintilianus informs us, that it prevailed in the Highlands in very early ages; and indeed the genius of the people seems to render the opinion highly probable. The attachment of that people to their music called pibrachs is almost incredible, and on some occasions is said to have produced effects little less marvellous than those ascribed to the ancient music. At the battle of Quebec in 1760, while the British troops were retreating in great disorder, the general complained to a field-officer in Fraser's regiment of the bad behaviour of his corps. " Sir (said he with some warmth), you did very wrong in forbidding the pipers to play this morning; nothing encourages the Highlanders so much in the day of action. Nay, even now they would be of use."—" Let them blow like the devil, then (replies the general), if it will bring back the men." The pipers were then ordered to play a favourite martial air; and the Highlanders, the moment they heard the music, returned and formed with alacrity in the rear. In the late war in India, Sir Eyre Coote, aware of the attachment of the Highlanders to their favourite instrument, gave them L. 50 to buy a pair of bag-pipes after the battle of Porto Nuovo.

Formerly there was a kind of college in the island of Skie where the Highland bag-pipe was taught; the teachers making use of pins stuck into the ground instead of musical notes. This college, however, has been for some time entirely dissolved, and the use of the Highland pipe became much less general than before. At last a society of gentlemen, thinking it perhaps impolitic to allow the ancient martial music of the country to decline, resolved to revive it by giving an annual prize to the best peformers on the instrument. These competitions were first held at Falkirk, but for a good number of years at Edinburgh; where the only surviving member of the ancient college of Skie is now *professor* of bag-pipe music.

The Lowland pipe, as has been already observed, is an instrument essentially different from the Highland pipe; it was reformed and the music improved by George Mackie, who is said to have attended the college of Skie seven years. He had before been the best performer on that instrument in that part of the country where he lived; but, while attending the college at Skie, he adapted the graces of the Highland music to the Lowland pipe. Upon his return, he was heard with astonishment and admiration; but unluckily, not being able to commit his improvements to writing, and indeed the nature of the instrument scarce admitting of it, the knowledge of this kind of music hath continued to decay ever since, and will probably soon wear out altogether. What contributes much to this is, that the bag-pipers, not content with the natural nine notes which their instrument can play easily, force it to play tunes requiring higher notes, which disorders the whole instrument in such a manner as to produce the most horrid discords; and this practice brings, though undeservedly, the instrument itself into contempt.

BAGUETTE, in architecture, a small round moulding, less than an astragal, and so called from the resemblance it bears to a ring.

BAHAMA, or Lucaya, Islands, are the eastermost of the Antilles, lying in the Atlantic ocean. They are situated to the south of Carolina, between 22 and 27 degrees N. Lat. and 73 and 81 degrees W. Long. They extend along the coast of Florida quite down to the

the isle of Cuba, and are said to be 500 in number, some of them only mere rocks; but twelve of them are large, fertile, and in nothing different from the soil of Carolina: all are, however, uninhabited except Providence, which is 200 miles east of the Floridas; though some others are larger and more fertile, on which the English have plantations. Between them and the continent of Florida is the gulf of Bahama, or Florida, through which the Spanish galeons sail in their passage to Europe.

These islands were the first fruits of Columbus's discoveries; but they were not known to the English till 1667, when Captain Seyle, being driven among them in his passage to Carolina, gave his name to one of them; and being a second time driven upon it, gave it the name of *Providence*. The English, observing the advantageous situation of these islands for being a check on the French and Spaniards, attempted to settle them in the reign of Charles II. Some unlucky accidents prevented this settlement from being of any advantage; and the isle of Providence became an harbour for the buccaneers or pirates, who for a long time infested the American navigation. This obliged the government in 1718 to send out Captain Woodes Rogers with a fleet to dislodge the pirates, and for making a settlement. This the captain effected; a fort was erected, and an independent company was stationed in the island. Ever since this last settlement these islands have been improving, though they advance but slowly. In time of war, people gain considerably by the prizes condemned there; and at all times by the wrecks which are frequent in this labyrinth of rocks and shelves. The Spaniards and Americans captured these islands during the last war; but they were retaken by a detachment from St Augustine April 7, 1783.

BAHAR, or Barre, in commerce, weights used in several places in the East Indies.

There are two of these weights; one the great bahar, with which they weigh pepper, cloves, nutmegs, ginger, &c. and contains 550 pounds of Portugal, or about 524 lb. 9 oz. averdupois weight. With the little bahar, they weigh quicksilver, vermilion, ivory, silk, &c. It contains about 437 lb. 9 oz. avoirdupois weight.

BAHAREN, an island in the Persian gulf, situated in E. Long. 50. 0. N. Lat. 26. 0. This island is chiefly remarkable for its pearl-fishery, and has often changed its masters. It fell with Ormus under the dominion of the Portuguese, was again restored to Persia by Thamas Khouli Kan; and after his death the confusion into which his empire was thrown, gave an opportunity to an enterprizing and ambitious Arab of taking possession of the island, where he still maintains his authority. Baharen was famous for its pearl-fishery even at the time when pearls were found at Ormus, Karek, Kashy, and other places in the Persian gulf; but it is now become of much greater consequence; all the other banks having been exhausted, while this has suffered no sensible diminution. The time of fishing begins in April, and ends in October. It is confined to a tract four or five leagues in breadth. The pearls taken at Baharen, though not so white as those of Ceylon or Japan, are much larger than those of the former place, and more regularly shaped than those of the latter. They have a yellowish colour; but have also this good quality, that they preserve their golden hue, whereas the whiter kind lose much of their lustre by keeping, especially in hot countries. The annual revenue from the Baharen pearl-fishery is computed at about L.157,500. The greatest part of the pearls that are uneven, are carried to Constantinople and other parts of Turkey, where the larger go to compose ornaments for head-dresses, and the smaller are used in embroideries. The perfect pearls must be reserved for Surat, whence they are distributed through all Indostan.

BAHI, a province of Lucon or Manila, one of the Philippine islands in the East Indies, belonging to the Spaniards. It is remarkable for producing excellent betel, which the inhabitants, Spaniards as well as natives, perpetually chew from morning till night. It is also the place where most of the ships are built. But the natives suffer much from this work; several hundreds of them being constantly employed in it, on the mountains, or at the port of Cavite. The king allows these labourers a piece-of-eight per month, with a sufficient quantity of rice. The whole province contains about 6000 tributary natives.

BAHIA, de todos los sanctos, a province of Brasil in South America, belonging to the Portuguese, and the richest in the whole country; but unhappily the air and climate do not correspond with other natural advantages: yet so fertile is the province in sugar and other commercial articles, that the Portuguese flock hither not only as it is the seat of affluence, but also of pleasure and grandeur. The capital, called *St Salvador*, or *Cividad de Bachia*, is populous, magnificent, and beyond comparison the most gay and opulent city in Brasil. It stands on a bay in S. Lat. 12. 11. is strong by nature, well fortified, and always defended by a numerous garrison. It contains 12,000 or 14,000 Portuguese, and about three times as many negroes, besides people of different nations who choose to reside in that city.

BAHIR, a Hebrew term signifying *famous or illustrious*; but particularly used for a book of the Jews, treating of the profound mysteries of the caballa, being the most ancient of the Rabinical works.

BAHUS, a strong town of Sweden, and capital of a government of the same name, seated on a rock in a small island, in E. Long. 11. 10. N. Lat. 57. 52.

BAJA, Bayjah, or Begia, a town of the kingdom of Tunis in Africa, supposed to be the ancient *Vacca* of Sallust, and *Oppidum Vaggense* of Pliny. It was formerly, and still continues to be, a place of great trade, and the chief market of the kingdom for corn; of which the adjacent territories produce such abundance, that they can supply more than the whole kingdom with it; and the Tunesians say, that if there was in the kingdom such another town as this for plenty of corn, it would become as cheap as sand. Here is also a great annual fair, to which the most distant Arabian tribes resort with their families and flocks. Notwithstanding all this, however, the inhabitants are very poor, and great part of the land about the town remains uncultivated, through the cruel exactions of the government, and the frequent incursions of the Arabs who are very powerful in these parts. The town stands on the declivity of a hill on the road to Constantina, about 10 leagues

Baja, Baiæ.

leagues from the northern coast, and 36 south-west from Tunis; and hath the convenience of being well watered. On the highest part is a citadel that commands the whole place, but is now of no great strength. The walls were raised out of the ruins of the ancient Vacca, and have some ancient inscriptions.

BAJA, a populous town of Hungary, seated on the Danube, in E. Long. 19. 50. N. Lat. 46. 40.

BAIÆ, an ancient village of Campania in Italy, between the promontory of Misenum and Puteoli, on the Sinus Baianus: famous for its natural hot baths, which served the wealthier Romans for the purposes both of medicine and pleasure.—The variety of those baths, the softness of its climate, and the beauty of its landscape, captivated the minds of opulent nobles, whose passion for bathing knew no bounds. Abundance of linen, and disuse of ointments, render the practice less necessary in modern life; but the ancients performed no exercise, engaged in no study, without previous ablutions, which at Rome required an enormous expence in aqueducts, stoves, and attendants: a place therefore, where waters naturally heated to every degree of warmth bubbled spontaneously out of the ground, in the pleasantest of all situations, was such a treasure as could not be overlooked. Baiæ was this place in the highest perfection; its easy communication with Rome was also a point of great weight. Hither at first retired for a temporary relaxation the mighty rulers of the world, to string anew their nerves and revive their spirits, fatigued with bloody campaigns and civil contests. Their habitations were small and modest: but soon increasing luxury added palace to palace with such expedition and sumptuosity, that ground was wanting for the vast demand: enterprising architects, supported by infinite wealth, carried their foundations into the sea, and drove that element back from its ancient limits: it has since taken ample revenge, and recovered much more than it ever lost. From being a place of resort for a season, Baiæ now grew up to a permanent city: whoever found himself disqualified by age, or infirmity, for sustaining any longer an active part on the political theatre; whoever, from an indolent disposition, sought a place where the pleasures of a town were combined with the sweets of a rural life; whoever wished to withdraw from the dangerous neighbourhood of a court, and the baneful eye of informers flocked hither, to enjoy life untainted with fear and trouble. Such affluence of wealthy inhabitants rendered Baiæ as much a miracle of art as it was before of nature; its splendor may be inferred from its innumerable ruins, heaps of marbles, mosaics, stucco, and other precious fragments of taste.—It flourished in full glory down to to the days of Theodoric the Goth, but the destruction of these enchanted palaces followed quickly upon the irruption of the northern conquerors, who overturned the Roman system, sacked and burnt all before them, and destroyed or dispersed the whole race of nobility. Loss of fortune left the Romans neither the means, nor indeed the thought, of supporting such expensive establishments, which can only be enjoyed in perfection during peace and prosperity. No sooner had opulence withdrawn her hand, than the unbridled sea rushed back upon its old domain; moles and buttresses were torn asunder and washed away; whole promontories, with the proud towers that once crowned their brows, were undermined and tumbled headlong into the deep, where, many feet below the surface, pavements of streets, foundations of houses, and masses of walls may still be descried. Internal commotions of the earth contributed also largely to this general devastation; mephitic vapours and stagnated waters have converted this favourite seat of health into the den of pestilence, at least during the estival heats: yet Baiæ in its ruined state, and stripped of all its ornaments, still presents many beautiful and striking subjects for the pencil. E. Long. 14. 45. N. Lat. 41. 6.

Swinburn's Sicily.

Bajador ‖ Bajazet.

BAJADOR, a cape on the west coast of Africa, south of the Canary Islands. W. Long. 15. 20. N. Lat. 27. 0.

BAIANUS SINUS, a bay so called from *Baiæ*, (Suetonius); *Portus Baiarum*, (Pliny); which was enlarged by Augustus, by giving entrance to the sea into the Lacus Lucrinus, and Averni, ordering it to be called *Portus Julius apud Baias*, (Suetonius). We also read *Baianus Lacus* in Tacitus, which some interpret the *Lucrinus*. The modern name is *Golfo di Pozzuolo*. From the highest point that forms the bay, a large castle commands the road, where foreign ships of war usually ride at anchor, the harbour of Naples not being spacious enough for the reception of a fleet: here they enjoy good sheltering, watering, and victualing; but in summer risk the health of their crews, on account of the unwholesomeness of the air.

BAJAZET I. sultan of the Turks, a renowned warrior, but a tyrant, was conquered by Tamerlane, and exposed by him in an iron cage; the fate he had destined (it is said) for his adversary if he had been the victor.

The iron cage, however, so long and so often repeated as a moral lesson, has been rejected as a fable by modern writers, who smile at the vulgar credulity. They appeal to the Persian history of Sherefeddin Ali, of which a French version has been given, and from which Mr Gibbon has collected the following more specious narrative of this memorable transaction. "No sooner was Timour informed that the captive Ottoman was at the door of his tent, than he graciously stepped forwards to receive him, seated him by his side, and mingled with just reproaches a soothing pity for his rank and misfortune. 'Alas!' said the Emperor, 'the decree of fate is now accomplished by your own fault: it is the web which you have woven; the thorns of the tree which yourself have planted. I wished to spare, and even to assist, the champion of the Moslems: you braved our threats, you despised our friendship; you forced us to enter your kingdom with our invincible armies. Behold the event. Had you vanquished, I am not ignorant of the fate which you reserved for myself and my troops. But I disdain to retaliate: your life and honour are secure; and I shall express my gratitude to God by my clemency to man.' The royal captive showed some signs of repentance, accepted the humiliation of a robe of honour, and embraced with tears his son Mousa, who at his request was sought and found among the captives of the field. The Ottoman princes were lodged in a splendid pavilion; and the respect of the guards could be surpassed only by their vigilance. On the arrival of the haram from Boursa, Timour restored the queen Despina and her daughter to their father and husband; but he piously

ously required, that the Servian princess, who had hitherto been indulged in the profession of Christianity, should embrace without delay the religion of the prophet. In the feast of victory, to which Bajazet was invited, the Mogul Emperor placed a crown on his head and a sceptre in his hand, with a solemn assurance of restoring him with an increase of glory to the throne of his ancestors. But the effect of this promise was disappointed by the sultan's untimely death: amidst the care of the most skilful physicians, he expired of an apoplexy at Akshehr, the Antioch of Pisidia, about nine months after his defeat. The victor dropped a tear over his grave; his body, with royal pomp, was conveyed to the mausoleum which he had erected at Boursa; and his son Mousa, after receiving a rich present of gold and jewels, of horses and arms, was invested by a patent in red ink with the kingdom of Anatolia.

Such is the portrait of a generous conqueror, which has been extracted from his own memorials, and dedicated to his son and grandson, 19 years after his decease; and, at a time when the truth was remembered by thousands, a manifest falsehood would have implied a satire on his real conduct. On the other hand, of the harsh and ignominious treatment of Bajazet there is also a variety of evidence. The Turkish annals in particular, which have been consulted or transcribed by Leunclavius, Pocock, and Cantemir, unanimously deplore the captivity of the iron cage; and some credit may be allowed to national historians, who cannot stigmatize the Tartar without uncovering the shame of their king and country."—From these opposite premises, Mr Gibbon thinks a fair and moderate conclusion may be deduced. He is satisfied that Sherefeddin Ali has faithfully described the first ostentatious interview, in which the conqueror, whose spirits were harmonised by success, affected the character of generosity. But his mind was insensibly alienated by the unseasonable arrogance of Bajazet; the complaints of his enemies, the Anatolian princes, were just and vehement; and Timour betrayed a design of leading his royal captive in triumph to Samarcand. An attempt to facilitate his escape by digging a mine under the tent, provoked the Mogul Emperor to impose a harsher restraint; and in his perpetual marches, an iron cage on a waggon might be invented, not as a wanton insult, but as a rigorous precaution. Timour had read in some fabulous history a similar treatment of one of his predecessors, a king of Persia; and Bajazet was condemned to represent the person and expiate the guilt of the Roman Cæsar. But the strength of his mind and body fainted under the trial, and his premature death might without injustice be ascribed to the severity of Timour. He warred not, however, with the dead; a tear and a sepulchre were all that he could bestow on a captive who was delivered from his power; and if Mousa, the son of Bajazet, was permitted to reign over the ruins of Boursa, the greatest part of the province of Anatolia had been restored by the conqueror to their lawful sovereigns.

BAIKAL, a great lake in Siberia, laying between 52 and 55 degrees north latitude. It is reckoned to be 500 wersts in length; but only 20 or 30 broad, and in some places not above 15. It is environed on all sides by high mountains. In one part of it, which lies near the river Bargusin, it throws up an inflammable sulphureous liquid called *Maltha*, which the people of the adjacent country burn in their lamps. There are likewise several sulphureous springs near this lake. Its water at a distance appears of a sea-green colour: it is fresh; and so clear, that objects may be seen in it several fathoms deep. It does not begin to freeze till near the latter end of December, and thaws again about the beginning of May: from which time till September, a ship is seldom known to be wrecked on it; but by the high winds which then blow, many shipwrecks happen. This lake is called by the neighbouring people *Swiatoie More*, or the *Holy Lake;* and they imagine, that when storms happen on it, they will be preserved from all danger by complimenting it with the title of *Sea*. When it is frozen over, people travel upon it in the road to China; but they must be very sharp-shod, otherwise they cannot stand upon the ice, which is exceedingly smooth. Notwithstanding that the ice on this lake is sometimes two ells thick, there are some open places in it to which tempestuous winds will often drive those who are crossing it, in which case they are irrecoverably lost. The camels that pass along have a particular kind of shoes sharp at bottom, and the oxen have sharp irons driven through their hoofs, without which it would be impossible for them to pass. Here are plenty of large sturgeon and pike; with many seals of the black, but none of the spotted kind. It contains several islands; and the borders are frequented by black sables and civet-cats.

BAIL, Ballium, from the French *bailler*, which comes of the Greek βαλλειν, and signifies to deliver into hands), is used in our common law for the freeing or setting at liberty of one arrested or imprisoned upon any action, either civil or criminal, on surety taken for his appearance at a day and place certain.

The reason why it is called *bail*, is because by this means the party restrained is delivered into the hands of those that bind themselves for his forthcoming, in order to a safekeeping or protection from prison; and the end of bail is to satisfy the condemnation and costs, or render the defendant to prison.

With respect to bail in civil cases, it is to be observed, that there is both common and special bail. Common bail is in actions of small concernment, being called *common*, because any sureties in that case are taken; whereas in causes of greater weight, as actions upon bonds, or specialty, &c. where the debt amounts to 10l. *special* bail or surety must be taken, such as subsidy men at least, and they according to the value.

The commitment of a person being only for safe custody, wherever bail will answer the same intention, it ought to be taken; as in most of the inferior crimes: but in felonies, and other offences of a capital nature, no bail can be a security equivalent to the actual custody of the person. For what is there that a man may not be induced to forfeit, to save his own life? and what satisfaction or indemnity is it to the public, to seize the effects of them who have bailed a murderer, if the murderer himself be suffered to escape with impunity? Upon a principle similar to which, the Athenian magistrates, when they took a solemn oath never to keep a citizen in bonds that could give three sureties of of the same quality with himself, did it with an exception to such as had embezzled the public money, or been guilty of treasonable practices.

Bail may be taken either in court, or, in some particular cases, by the sheriff or other magistrate; but most usually by the justices of the peace. To refuse or delay to bail any person bailable, is an offence against the liberty of the subject, in any magistrate, by the common law; as well as by the statute Westm. 1. 3. Edw. I. c. 15. and the *habeas corpus* act, 31 Car. II. c. 2. And, lest the intention of the law should be frustrated by the justices requiring bail to a greater amount than the nature of the case demands, it is expressly declared by statute 1 W. & M. st. 2. c. 1. that excessive bail ought not to be required; though what bail shall be called *excessive*, must be left to the courts, on considering the circumstances of the case, to determine. And on the other hand, if the magistrate takes insufficient bail he is liable to be fined, if the criminal doth not appear.

In *civil* cases, every defendant is bailable. But it is otherwise in

Criminal matters. Regularly, all offences either against the common law or act of parliament, that are below felony, the offender ought to to be admitted to bail unless it be prohibited by some special act of parliament.—By the ancient common law, before and since the conquest, all felonies were bailable, till murder was excepted by statute: so that persons might be admitted to bail almost in every case. But the statute West. 1. 3 Ed. I. c. 15. takes away the power of bailing in treason, and in divers instances of felony. The statutes 23 Hen. VI. c. 9. and 1 and 2 Ph. and Mar. c. 13. gave farther regulations in this matter: and upon the whole we may collect, that no justices of the peace can bail, 1. Upon an accusation of treason: nor, 2. Of murder: nor 3. In case of manslaughter, if the prisoner be clearly the slayer, and not barely suspected to be so; or if any indictment be found against him; nor 4. Such as, being committed for felony, have broken prison; because it not only carries a presumption of guilt, but is also superadding one felony to another: 5. Persons outlawed: 6. Such as have abjured the realm: 7. Persons taken with the mainour, or in the fact of felony: 8. Persons charged with Arson: 9. Excommunicated persons, taken by writ *de excommunicato capiendo*: all which are clearly not admissible to bail by the justices. Others are of a dubious nature, as, 10. Thieves openly defamed and known: 11. Persons charged with other felonies, or manifest and enormous offences, not being of good fame: and, 12. Accessories to felony, that labour under the same want of reputation. These seem to be in the discretion of the justices, whether bailable or not. The last class are such as *must* be bailed upon offering sufficient surety; as, 13. Persons of good fame, charged with a bare suspicion of manslaughter, or other infamous homicide; 14. Such persons being charged with petit larceny or any felony, not before specified: or, 16. With being accessory to any felony. Lastly, it is agreed, that the court of king's bench (or any judge thereof in time of vacation) may bail for any crime whatsoever, be it treason, murder, or any other offence, according to the circumstances of the case. And herein the wisdom of the law is very manifest. To allow bail to be taken commonly for such enormous crimes, would greatly tend to elude the public justice: and yet there are cases, though they rarely happen, in which it would be hard and unjust to confine a man in prison, though accused even of the greatest offence. The law has therefore provided one court, and only one, which has a discretionary power of bailing in any case: except only, even to this high jurisdiction, and of course to all inferior ones, such persons as are committed by either house of parliament, so long as the session lasts; or such as are committed for contempts by any of the king's superior courts of justice. See Law, Part III. N° xxxvi. 42.

Clerk of the Bails, is an officer belonging to the court of the King's Bench: he files the bail-pieces taken in that court, and attends for that purpose.

Bail, or Bale, in the sea-language. The seamen call throwing the water by hand out of the ship's or boat's hold, *bailing*. They also call those hoops that bear up the tilt of a boat, its *bails*.

BAILIE, in Scots law, a judge anciently appointed by the king over such lands not erected into a regality as happened to fall to the crown by forfeiture or otherwise, now abolished. It is also the name of a magistrate in royal boroughs, and of the judge appointed by a baron over lands erected into a barony. See Law, Part III. N° cxviii. 6, 7.

BAILIFF *(ballivus)*, from the French word *bayliff*, that is, *præfectus provinciæ*: and as the names, so the office itself was answerable to that of France; where there are eight parliaments, which are high courts from whence there lies no appeal, and within the precincts of the several parts of that kingdom which belong to each parliament there are several provinces to which justice is administered by certain officers called *bailiffs*; and in England there are several counties in which justice hath been administered to the inhabitants by the officer who is now called *sheriff* or *viscount* (one of which names descends from the Saxons, the other from the Normans); and though the sheriff is not called *bailiff*, yet it is probable that was one of his names also, because the county is often called *balliva*. And in the statute of Magna Charta, cap. 28. and 14 Ed. 3. c. 9. the word *bailiff* seems to comprise as well sheriffs as bailiffs of hundreds. As the realm is divided into counties, so every county is divided into hundreds; within which in ancient times the people had justice ministered to them by the officers of every hundred. But now the hundred courts, except certain franchises, are swallowed in the county-courts; and the bailiff's name and office is grown into contempt, they being generally officers to serve writs, &c. within their liberties. Though, in other respects, the name is still in good esteem: for the chief magistrates in divers town are called *bailiffs* or *bailies*; and sometimes the persons to whom the king's castles are committed are termed *bailiffs*, as the *bailiff of Dover castle*, &c.

Of the ordinary bailiffs there are several sorts, *viz.* sheriff's bailiffs, bailiffs of liberties, &c.

Sheriff's bailiffs, or sheriff's officers, are either bailiffs of hundreds, or special bailiffs. Bailiffs of hundreds are officers appointed over those respective districts by the sheriffs, to collect fines therein; to summon juries; to attend the judges and justices at the assises, and quarter-sessions; and also to execute writs and process in the ſeveral hundreds. But as theſe are generally plain men, and not thoroughly ſkilful in this latter part of their office, that of ſerving writs, and making arreſts and executions, it is now uſual to join ſpecial bailiffs with them; who are generally mean perſons employed by the ſheriffs on account only of their adroitneſs and dexterity in hunting and ſeizing of their prey.

Bailiffs of liberties are thoſe bailiffs who are appointed by every lord within his liberty, to execute proceſs and do ſuch offices therein as the bailiff errant doth at large in the county; but bailiffs errant or itinerant, to go up and down the county to ſerve proceſs, are out of uſe.

There are alſo bailiffs of foreſts, and bailiffs of manors, who direct huſbandry, fell trees, gather rents, pay quit-rents, &c.

Water Bailiff, an officer appointed in all port-towns, for the ſearching of ſhips, gathering the toll for anchorage, &c. and arreſting perſons for debt, &c. on the water.

BAILII (David), painter of perſpective views and portraits, was the ſon of Peter Bailii, an artiſt of ſome note; and was born at Leyden in 1584. From his father he learned to draw and deſign: but he was afterwards placed under the care of Adrian Verburg, and continued with him for ſome time; and when he quitted that maſter, he ſtudied to much greater advantage with Cornelius Vandervoort, an excellent portrait painter, and with him he ſpent above ſix years. As Vandervoort poſſeſſed many capital paintings of ſome great maſters, Bailii, for his own improvement, copied them with critical care and obſervation; and particularly copied one perſpective view of the inſide of a church, originally painted by Stenwyck, which he finiſhed with ſuch accuracy, that even Stenwyck himſelf could ſcarce determine which was the original, or which the copy, when both were placed before him. He travelled through ſeveral parts of Italy, to ſee the works of the celebrated maſters of that country, and for a few years reſided at Rome; and abroad, as well as in his own country, the correctneſs of his drawing, and the delicate handling and finiſhing of his pictures, procured him employment, admirers, and friends. In the latter part of his life he diſcontinued painting, and only drew portraits on vellum with a pen, which he heightened with black lead, and gave them wonderful force and roundneſs. He died in 1638.

BAILIWICK, that liberty which is exempted from the ſheriff of the county; over which liberty the lord thereof appoints his own bailiff, with the like power within his precinct as an under ſheriff exerciſes under the ſheriff of the county: Or it ſignifies the precinct of a bailiff, or the place within which his juriſdiction is terminated.

BAILLET (Adrian), a very learned French writer and critic, born in 1649, at the village of Neuville near Beauvais in Picardy. His parents were too poor to give him a proper education, which however he obtained by the favour of the Biſhop of Beauvais, who afterwards preſented him with a ſmall vicarage. In 1680, he was appointed librarian to M. de Lamoignon, advocate general to the parliament of Paris; of whoſe library he made a copious index in 35 vols folio, all written with his own hand. He died in 1706, after writing many works, the principal of which are, *A Hiſtory of Holland from* 1609, *to the peace of Nimeguen in* 1679, 4 vols 12mo; *Lives of the Saints*, 3 vols folio, which he profeſſed to have purged from fables; *Jugemens des Sçavans*, which he extended to 9 vols 12mo; and *The Life of Des Cartes*, 2 vols 4to, which he abridged, and reduced to 1 vol. 12mo.

BAILLEUL, a town of France, in the earldom of Flanders, formerly very ſtrong, but now without any fortifications. It has been ſeveral times burnt by accident, and contains now only about 500 houſes. E. Long. 2. 55. N. Lat. 40. 35.

BAILMENT, in law, is a delivery of goods in truſt, upon a contract, expreſſed or implied, that the truſt ſhall be faithfully executed on the part of the bailee. As if cloth be delivered, or (in our legal dialect) bailed, to a taylor to make a ſuit of clothes, he has it upon an implied contract to render it again when made, and that in a workmanly manner. If money or goods be delivered to a common carrier, to convey from Oxford to London, or from Glaſgow to Edinburgh, &c. he is under a contract in law to pay, or carry them to the perſon appointed. If a horſe or other goods be delivered to an inn-keeper or his ſervants, he is bound to keep them ſafely, and reſtore them when his gueſt leaves the houſe. If a man takes in a horſe, or other cattle, to graze and depaſture in his grounds, which the law calls *agiſtment*, he takes them upon an implied contract to return them on demand to the owner. If a pawnbroker receives plate or jewels as a pledge or ſecurity for the repayment of money lent thereon at a day certain, he has them upon an expreſs contract or condition to reſtore them if the pledger performs his part by redeeming them in due time: for the due execution of which contract, many uſeful regulations are made by ſtatute 30 Geo. II. c. 24. And ſo, if a landlord diſtrains goods for rent, or a pariſh officer for taxes, theſe for a time are only a pledge in the hands of the diſtrainers, and they are bound by an implied contract in law to reſtore them on payment of the debt, duty, and expences, before the time of ſale; or when ſold, to render back the overplus. If a friend delivers any thing to his friend to keep for him, the receiver is bound to reſtore it on demand: and it was formerly held, that in the mean time he was anſwerable for any damage or loſs it might ſuſtain, whether by accident or otherwiſe; unleſs he expreſsly undertook to keep it only with the ſame care as his own goods, and then he ſhould not be anſwerable for theft or other accidents. But now the law ſeems to be ſettled on a much more rational footing; that ſuch a general bailment will not charge the bailee with any loſs, unleſs it happens by groſs neglect, which is conſtrued to be an evidence of fraud: but if the bailee undertakes ſpecially to keep the goods ſafely and ſecurely, he is bound to anſwer all perils and damages that may befal them for want of the ſame care with which a prudent man would keep his own.

BAILO; thus they ſtyle at Conſtantinople the ambaſſador of the republic of Venice, who reſides at the Porte. This miniſter, beſides his political charge, acts there the part of a conſul of Venice.

BAINBRIDGE (Dr John), an eminent phyſician and aſtronomer, born at Aſhby de la Zouche in Leiceſterſhire, in 1582. He taught a grammar ſchool for ſome years, and practiſed phyſic, employing his leiſure

hours

hours in astronomy, which was his favourite study: at length he removed to London, was admitted a fellow of the college of physicians, and raised his character by his description of the comet in 1618. The next year Sir Henry Savile appointed him his first professor of astronomy at Oxford; and the masters and fellows of Merton-college made him first junior, and then superior, reader of Linacre's lecture. He died in 1643, having written many works, some of which have never been published: but the MSS. are preserved in the library of Trinity-college, Dublin.

BAIOCAO, a copper-coin, current at Rome, and throughout the whole state of the church, ten of which make a Julio, and an hundred a Roman crown.

BAIRAM, or BEIRAM, a Turkish word which signifies a solemn feast. The Mahometans have two Bairams, the *Great* and the *Little*. The *Little* Bairam is properly that held at the close of the fast Ramazan, beginning with the first full moon in the following month Shawal. This is called in Arabic *Id al Fetz, or the Feast of breaking the fast;* by European writers, *the Turkish Easter*, because it succeeds Ramazan, which is their Lent, more usually the *Great Bairam*, because observed with great ceremony and rejoicing at Constantinople, and through Turkey, for three days, and in Persia for five or six days, at least by the common people, to make themselves amends for the mortification of the preceding month.—The feast commencing with the new moon, the Mahometans are very scrupulous in observing the time when the new moon commences; to which purpose, observers are sent to the tops of the highest mountains, who the moment they spy the appearance of a new moon, run to the city, and proclaim *Muzhdaluk*, "welcome news;" as it is the signal for beginning the festivity.—The *Great Bairam*, is properly that held by the pilgrims at Mecca, commencing on the tenth of Dhu Ihajia, when the victims are slain, and lasting three days. This is called by the Arabs, *Id al adha*, that is, *the feast of sacrifice*, as being celebrated in memory of the sacrifice of Abram, whose son God redeemed with a great victim. By European writers it is called the *Lesser Bairam*, as being less taken notice of by the generality of the people, who are not struck with it, because the ceremonies, it is observed withal, are performed at Mecca, the only scene of the solemnity.——On the feast of Bairam, after throwing little stones, one after another, into the valley of Mina, they usually kill one or more sheep, some a goat, bullock, or even a camel; and after giving a part thereof to the poor, eat the rest with their friends. After this, they shave themselves. The second is a day of rest. On the third, they set out on their return home.

BAIROUT. See BEEROOT.

BAIT, among fishermen, implies a substance proper to be fastened to a hook, in order to catch the different sorts of fish. See FISHING.

BAITING, the act of smaller or weaker beasts attacking and harassing greater and stronger. In this sense we hear of the baiting of bulls or bears by mastiffs, or bull-dogs with short noses, that they may take the better hold.

Utility is pled in justification of *bull-baiting*. This animal is rarely killed without being first baited; the chaffing and exercise whereof makes his flesh tenderer and more digestible. In reality, it disposes it for putrefaction; so that, unless taken in time, baited flesh is soon lost. But a spirit of barbarism had the greatest share in supporting the sport: bulls are kept on purpose, and exhibited as standing spectacles for the public entertainment. The poor beasts have not fair play: they are not only tied down to a stake, with a collar about their necks, and a short rope, which gives them not above four or five yards play; but they are disarmed too, and the tips of their horns cut off, or covered with leather, to prevent their hurting the dogs. In this sport, the chief aim of the dog is to catch the bull by the nose, and hold him down; to which end, he will even creep on his belly: the bull's aim, on the contrary, is, with equal industry, to defend his nose; in order to which, he thrusts it close to the ground, where his horns are also in readiness to toss the dog.—Bull-baiting was first introduced into England as an amusement in the reign of king John, about 1209.

BAJULUS, an ancient officer in the court of the Greek emperors. There were several degrees of bajuli; as, the grand *Bajulus*, who was preceptor to the emperor; and the simple *bajuli*, who were sub-preceptors. The word is derived from the Latin verb *bajulare*, "to carry or bear a thing on the arms or the shoulders;" and the origin of the office is thus traced by antiquaries. Children, and especially those of condition, had anciently, besides their nurse, a woman called *gerula*, as appears from several passages of Tertullian; when weaned, or ready to be weaned, they had men to carry them about and take care of them, who were called *geruli* and *bajuli*, *a gerendo et bajulando*. Hence it is, that governors of princes and great lords, were still denominated *bajuli*, and their charge or government *bajulatio*, even after their pupils were grown too big to be carried about. The word passed in the same sense into Greece.

BAJULUS is also used by Latin writers in the several other senses wherein BAILIFF is used among us.

BAJULUS was also the name of a conventual officer in the ancient monasteries, to whom belonged the charge of gathering and distributing the money and legacies left for masses and obits; whence he was also denominated *bajulus obituum novorum*.

BAKAN, a large and handsome town of Asia in the East Indies, in the kingdom of Ava. E. Long. 98. 0. N. Lat. 19. 35.

BAKER (Sir Richard), author of the Chronicle of the kings of England, was born at Sissingherst, in Kent, about the year 1568. After going through the usual course of academical learning at Hart-hall, in Oxford, he travelled into foreign parts; and upon his return home was created master of arts, and soon after, in 1603, received from king James I. the honour of knighthood. In 1620, he was high sheriff of Oxfordshire; but engaging to pay some of the debts of his wife's family, he was reduced to poverty, and obliged to betake himself for shelter to the Fleet prison, where he composed several books; among which are, 1. Meditations and Disquisitions on the Lord's Prayer. 2. Meditations, &c. on several of the Psalms of David. 3. Meditations and Prayers upon the seven days of the Week. 4. *Cato Variegatus*, or Cato's Moral Distichs varied, &c.—Mr Granger observes, that his Chronicle of the Kings of England was ever more esteemed

by

Baker.

by readers of a lower class than by such as had a critical knowledge of history. The language of it was, in this reign, called polite; and it long maintained its reputation, especially among country gentlemen. The author seems to have been sometimes more studious to please than to inform, and with that view to have sacrificed even chronology itself to method. In 1658, Edward Philips, nephew to Milton, published a third edition of this work, with the addition of the reign of Charles I. It has been several times reprinted since, and is now carried as low as the reign of George I. Sir Richard also translated several works from the French and Italian; and died very poor, in the Fleet prison, on the 18th of February 1645.

Baker (Thomas), an eminent mathematician, was born at Ilton in Somersetshire, about the ye r 1625, and entered at Magdalen-hall, Oxon, in 1640; after which he was vicar of bishop's-Nymmet, in Devonshire, where he wrote The Geometrical Key, or the Gate of Equations unlocked; by which he gained a considerable reputation. A little before his death, the members of the Royal Society sent him some mathematical queries, to which he returned so satisfactory an answer, that they presented him a medal, with an inscription full of honour and respect. He died at Bishop's-Nymmet on the 5th of June 1690.

Baker (Thomas), a very ingenious and learned antiquary, descended from a family ancient and well esteemed, distinguished by its loyalty and affection for the crown, was born at Crook in 1656. He was educated at the free school at Durham, and thence removed to St John's college Cambridge in 1674. He proceeded B. A. 1677; M. A. 1681; was elected fellow March 1679-80; ordained deacon by Bishop Compton of London December 20. 1685; priest by Bishop Barlow of Lincoln December 19. 1686. Dr Watson, tutor of the college, who was nominated, but not yet consecrated bishop of St David's, offered to take him for his chaplain, which he declined, probably on the prospect of a like offer from Lord Crew bishop of Durham, which he soon after accepted. His Lordship collated him to the rectory of Long-Newton in his diocese, and the same county, June 1687; and, as Dr Grey was informed by some of the bishop's family, intended to have given him that of Sedgefield, worth L. 600 or L. 700 a-year, with a golden prebend, had he not incurred his displeasure and left his family for refusing to read King James II.'s declaration for liberty of conscience. The bishop, who disgraced him for this refusal, and was excepted out of King William's pardon, took the oaths to that king, and kept his bishopric till his death. Mr Baker resigned Long-Newton August 1. 1690, refusing to take the oaths; and retired to his fellowship at St John's, in which he was protected till January 20, 1716-17, when, with one and twenty others, he was dispossessed of it. After the passing the Registering Act 1723, he was desired to register his annuity of L. 40, which the last act required before it was amended and explained. Though this annuity, left him by his father for his fortune, with L. 20 *per annum* out of his collieries by his elder brother from the day of his death August 1699, for the remaining part of the lease, which determined at Whitsuntide 1723, was now his whole subsistence, he could not be prevailed on to secure himself against the act. He retained a lively resentment of his deprivations; and wrote himself in all his books, as well as in those which he gave to the college library, *socius ejectus*, and in some *ejectus rector*. He continued to reside in the college as commoner-master till his death, which happened July 2. 1740, of a paralytic stroke, being found on the floor of his chamber. In the afternoon of June 29, being alone in his chamber, he was struck with a slight apoplectic fit; which abating a little, he recovered his senses, and knew all about him, who were his nephew Burton, Drs Bedford and Heberden. He seemed perfectly satisfied and resigned; and when Dr Bedford desired him to take some medicine then ordered, he declined it, saying, he would only take his usual sustenance, which his bed-maker knew the times and quantities of giving: he was thankful for the affection and care his friends showed him; but, hoping the time of his dissolution was at hand, would by no means endeavour to retard it. His disorder increased, and the third day from this seizure he departed. Being appointed one of the executors of his eldest brother's will, by which a large sum was bequeathed to pious uses, he prevailed on the other two executors, who were his other brother Francis and the hon. Charles Montague, to lay out L. 1310 of the money upon an estate to be settled upon St John's college for six exhibitioners. He likewise gave the college L. 100 for the consideration of L. 6 a-year (then only legal interest) for his life; and to the library several choice books, both printed and MS. medals, and coins; besides what he left to it by his will; which were "all such books, printed and MS. as he had, and were wanting there." All that Mr Baker printed was, 1. Reflections on Learning, showing the insufficiency thereof in its several particulars, in order to evince the usefulness and necessity of Revelation, Lond. 1709-10" (which went through eight editions, and Mr Boswell, in his "Method of Study," ranks it among the English classics for purity of style); and, 2. The Preface to Bishop Fisher's Funeral Sermon for Margaret Countess of Richmond and Derby, 1708;" both without his name. Dr Grey had the original MS. of both in his own hands. The latter piece is a sufficient specimen of the editor's skill in antiquities to make us regret that he did not live to publish his "History of St John's college, from the foundation of old St John's house to the present time; with some occasional and incidental account of the affairs of the university, and of such private colleges as held communication or intercourse with the old house or college: collected principally from MSS. and carried on through a succession of masters to the end of Bishop Gunning's mastership, 1670." The original, fit for the press, is among the Harleian MSS. N° 7028. His MS. collections relative to the history and antiquities of the university of Cambridge, amounting to 39 volumes in folio and three in quarto, are divided between the British Museum and the public library at Cambridge; the former possesses 23 volumes, which he bequeathed to the Earl of Oxford, his friend and patron; the latter 16 in folio, and three in quarto, which he bequeathed to the university. Dr Knight styles him "the greatest master of the antiquities of this our university;" and Hearne says, *Optandum est ut sua quoque collectanea de antiquitatibus Cantabrigiensibus juris faciat publici Cl. Backerus, quippe qui eruditione*

Baker. *tione summa judicioque acri et subacto polleat.* Mr Baker intended something like an *Athenæ Cantabrigienses*, on the plan of the *Athenæ Oxonienses*.

BAKER (Henry), an ingenious and diligent naturalist, was born in Fleet-street London, either near the end of the last, or very early in the beginning of the present century. His father's profession is not known; but his mother was, in her time, a midwife of great practice. He was brought up under an eminent bookseller who preceded the elder Dodsley to the business of a bookseller; in which, however, he appears not to have engaged at all after his apprenticeship; or, if he did, it was soon relinquished by him: for though it was in his power to have drawn away all his master's best customers, he would not set up against him. Mr Baker being of a philosophical turn of mind, and having diligently attended to the methods which might be practicable and useful in the cure of stammering, and especially in teaching deaf and dumb persons to speak, he made this the employment of his life. In the prosecution of so valuable and difficult an undertaking, he was very successful; and several of his pupils, who are still living, bear testimony to the ability and good effect of his instructions. He married Sophia, youngest daughter of the famous Daniel Defoe, who brought him two sons, both of whom he survived. On the 29th of January 1740, Mr Baker was elected a fellow of the Society of Antiquaries; and, on the 12th of March following, the same honour was conferred upon him by the Royal Society. In 1744, Sir Godfrey Copley's gold medal was bestowed upon him, for having, by his microscopical experiments on the crystallizations and configurations of saline particles, produced the most extraordinary discovery during that year. Having led a very useful and honourable life, he died at his apartments in the Strand on the 25th of November 1774, being then above 70 years of age. His wife had been dead some time before; and he only left one grandson, William Baker, who was born February 17. 1763, and to whom, on his living to the age of 21, he bequeathed the bulk of his fortune, which he had acquired by his profession of teaching deaf and dumb persons to speak. His furniture, printed books (but not MSS.), curiosities, and collections of every sort, he directed should be sold, which was accordingly done. His fine collection of native and foreign fossils, petrifactions, shells, corals, vegetables, ores, &c. with some antiquities and other curiosities, were sold by auction March 13. 1775, and the nine following days. He was buried, as he desired, in an unexpensive manner, in the church-yard of St Mary-le-strand; within which church, on the south wall he ordered a small tablet to be erected to his memory. "An inscription for it (he said) would probably be found among his papers; if not, he hoped some learned friend would write one agreeably to truth." This friendly office, however, remains as yet to be performed. Mr. Baker was a constant and useful attendant at the meetings of the Royal and Antiquarian Societies, and in both was frequently chosen one of the council. He was peculiarly attentive to all the new improvements which were made in natural science, and very solicitous for the prosecution of them. Several of his communications are printed in the Philosophical Transactions; and, besides the papers written by himself, he was the means, by his extensive correspondence, of conveying to the Society the intelligence and observations of other inquisitive and philosophical men, both at home and abroad. The Society for the encouragement of arts, manufactures, and commerce, is under singular obligations to our worthy naturalist. As he was one of the earliest members of it, so he contributed in no small degree to its rise and establishment. At its first institution he officiated for some time *gratis* as secretary. He was many years chairman of the committee of accounts; and he took an active part in the general deliberations of the Society. He drew up a short account of the original of this society, and of the concern he himself had in forming it; which was read before the society of antiquaries, and would be a pleasing present to the public. Mr Baker was a poetical writer in the early part of his life. His *Invocation of Health* got abroad without his knowledge; but was reprinted by himself in his *Original Poems, serious and humorous*, Part I. 8vo, 1725. Part II. came out in 1726. Among these poems are some tales as witty and as loose as Prior's. He was the author likewise of *The Universe*, a poem intended to restrain the pride of man; which has been several times reprinted. His account of the water polype, which was originally published in the Philosophical Transactions, was afterwards enlarged into a separate treatise, and hath gone through several editions. But his principal publications are, *The Microscope made Easy*, and *Employment for the Microscope*. The first of these, which was originally published in 1742, or 1743, hath gone through six editions. The second edition of the other, which to say the least of it, is equally pleasing and instructive, appeared in 1764. These treatises, and especially the latter, contain the most curious and important of the observations and experiments which Mr Baker either laid before the Royal Society or published separately. It has been said of Mr Baker that *he was a philosopher in little things*. If it was intended by this language to lessen his reputation, there is no propriety in the stricture. He was an intelligent, upright, and benevolent man, much respected by those who knew him best. His friends were the friends of science and virtue: and it will always be remembered by his cotemporaries, that no one was more ready than himself to assist those with whom he was conversant in their various researches and endeavours for the advancement of knowledge and the benefit of society.

BAKER (David-Erskine), son to the former, was a young man of genius and learning. Having been adopted by an uncle, who was a silk-throwster in Spitalfields, he succeeded him in the business; but wanted the prudence and attention which are necessary to secure prosperity in trade. He married the daughter of Mr Clendon, a reverend empiric. Like his father, he was both a philosopher and a poet; and wrote several occasional poems in the periodical collections, some of which were much admired at the time; but so violent was his turn for dramatic performance, that he repeatedly engaged with the lowest strolling companies, in spite of every effort of his father reclaim him. The public was indebted to him for "The Companion to the

the Play-house," in two volumes, 1764, 12mo; a work which, though imperfect, had considerable merit, and showed that he possessed a very extensive knowledge of our dramatic authors; and which has since (under the title of "Biographia Dramatica") been considerably improved by the attention of a gentleman in every respect well qualified for the undertaking.

BAKER, a person whose occupation or business is to bake bread. See the articles BAKING and BREAD.

The learned are in great doubt about the time when baking first became a particular profession and bakers were introduced. It is however generally agreed, that they had their rise in the east, and passed from Greece to Italy after the war with Pyrrhus, about the year of Rome 583. Till which time every housewife was her own baker; for the word *pistor*, which we find in Roman authors before that time, signified a person who ground or pounded the grain in a mill or mortar to prepare it for baking, as Varro observes. According to Athenæus, the Cappadocians were the most applauded bakers, after them the Lydians, then the Phœnicians.—To the foreign bakers brought into Rome, were added a number of freed-men, who were incorporated into a body, or as they called it, a *college*; from which neither they nor their children were allowed to withdraw. They held their effects in common, and could not dispose of any part of them. Each bake-house had a patronus, who had the superintendency thereof; and these patroni elected one out of their number each year, who had superintendence over all the rest, and the care of the college. Out of the body of the bakers were every now and then one admitted among the senators.—To preserve honour and honesty in the college of bakers, they were expresly prohibited all alliance with comedians and gladiators; each had his shop or bake-house, and they were distributed into fourteen regions of the city. They were excused from guardianships and other offices, which might divert them from their employment.—By our own statutes bakers are declared not to be handicrafts. No man for using the mysteries or sciences of baking, brewing, surgery, or writing, shall be interpreted a handicraft. The bakers were a brotherhood in England before the year 1155, in the reign of king Henry II. though the white bakers were not incorporated till 1337, by king Edward III. and the brown bakers not till 1621, in king James I.'s time. Their hall is in Harp-lane, Thames-street; and their court-day on the first Monday of the month.—They make the 19th company; and consist of a warden, 4 masters, 30 assistants, and 140 men on the livery, besides the commonalty.—The French had formerly a great baker, *grand panetier de France*, who had the superintendency of all the bakers of Paris. But since the beginning of this century, they have been put under the jurisdiction of the lieutenant-general *de police*. In some provinces of France, the lord is the only baker in his seigneury; keeping a public oven, to which all the tenants are obliged to bring their bread. This right is called *furnagium*, or *furnaticum*, and makes part of the *bannalite*.

BAKEWELL, a pretty large town of Derbyshire, in England, seated on the river Wye, on the North-side of the Peak. It has a considerable trade in lead. W. Long. 2. 30. N. Lat. 55. 15.

BAKING, the art of preparing bread, or reducing meals of any kind, whether simple or compound, into bread. See the article BREAD.

The various forms of baking among us may be reduced into two, the one for unleavened, the other for leavened bread. For the first, the chief is manchet-baking; the process whereof is as follows. The meal, ground and boulted, is put into a trough; and to every bushel are poured in about three pints of warm ale, with barm and salt to season it. This is kneaded well together, with the hands through the brake; or, for want thereof, with the feet, through a cloth: after which, having lain an hour to swell, it is moulded into manchets; which, scorched in the middle, and pricked up at top, to give room to rise, are baked in the oven by a gentle fire.—For the second, sometimes called *cheat-bread baking*, it is thus: Some leaven (saved from a former batch) filled with salt, laid up to sour, and at length dissolved in water, is strained through a cloth into a hole made in the middle of the heap of meal in the trough; then it is worked with some of the flour into a moderate consistence: this is covered up with meal, where it lies all night; and in the morning the whole heap is stirred up, and mixed with a little warm water, barm, and salt, by which it is seasoned, softened, and brought to an even leaven: it is then kneaded, moulded, and baked, as before.

Method of raising a bushel of flour, with a tea-spoonful of barm; by James Stone, of Amport, in Hampshire.—Suppose you want to bake a bushel of flour, and have but one tea-spoonful of barm. Put your flour into your kneading-trough or trendle; then take about three quarters of a pint of warm water, and take the tea-spoonful of thick steady barm and put it into the water, stir it until it is thoroughly mixed with the water: then make a hole in the middle of the flour large enough to contain two gallons of water, pour in your small quantity; then take a stick about two feet long, (which you may keep for that purpose), and stir in some of the flour, until it is as thick as you would make batter for a pudding: then strew some of the dry flour over it, and go about your usual business for about an hour: then take about a quart of warm water more, and pour in; for in one hour you will find that small quantity raised so, that it will break through the dry flour which you shook over it; and when you have poured in the quart of warm water, take your stick as before, and stir in some more flour, until it is as thick as before; then shake some more dry flour over it, and leave it for two hours more, and then you will find it rise and break through the dry flour again; then you may add three quarts or a gallon of water more, and stir it in the flour and make it as thick as at first, and cover it with dry flour again; in about three or four hours more you may mix up your dough, and then cover it up warm; and in four or five hours more you may put it into the oven, and you will have as light bread as though you had put a pint of barm. It does not take above a quarter of an hour more time than the usual way of baking, for there is no time lost but that of adding water three or four times.

The author of this method assures us, that he constantly bakes this way in the morning about six or seven o'clock, puts the flour out, and puts this small quantity of barm into the before-mentioned quantity of water, in an hour's time some more, in two hours more

Baking, Bakou. a greater quantity, about noon makes up the dough, and about ſix in the evening it is put into the oven, and he has always good bread, never heavy nor bitter.

When you find, he ſays, your body of flour ſpunged large enough, before you put in the reſt of your water, you ſhould, with both your hands, mix that which is ſpunged and the dry flour altogether, and then add the remainder of warm water, and your dough will riſe the better and eaſier.

The reaſon he aſſigns why people make heavy bread is, not becauſe they have not barm enough, but becauſe they do not know that barm is the ſame to flour as fire is to fuel; that, as a ſpark of fire will kindle a large body by only blowing of it up, ſo will a thimblefull of barm, by adding of warm water, raiſe or ſpunge any body of flour; for warm water gives freſh life to that which is before at work: ſo that the reaſon of making bread heavy is, becauſe the body ſpunged is not large enough, but was made up and put into the oven before it was ripe.

In regard to the difference of ſeaſons, he preſcribes, that in the ſummer you ſhould put your water blood-warm; and in winter, in cold froſty weather, as warm as you can bear your hand in it without making it ſmart; being ſure you cover up your dough very warm in the winter, and your covering of it with dry flour every time you add warm water, will keep in the heat; when you have added ſix or eight quarts of warm water, as before mentioned, in ſuch a gradual way, you will find all that body of flour which is mixed with the warm water, by virtue of that one tea-ſpoonful of barm, brought into great agitation, waxing or fermenting; for it is to the flour what the ſpirit is to the body, it ſoon fills it with motion.

BAKOU, or Baku, a town of Perſia, in the province of Shirvan, ſituated at the extremity of the Gulf of Ghilan on the Caſpian Sea. It is eſteemed the moſt commodious haven in this ſea, as veſſels may there ride ſecurely at anchor in ſeven fathom water; but the number of ſhoals, iſlands, and ſand-banks, render the entrance in ſome places extremely difficult and dangerous, particularly to the Ruſſians, who are not very expert ſailors. Baku is a fortreſs ſurrounded with high brick walls; its inhabitants, like thoſe of Derbent, are Perſians, Tartars, and a few Armenian merchants. The principal articles of exportation which ſupport the trade of this place are naphtha, and the fineſt rock ſalt, of both which there are mines on the eaſt ſide of the bay. The inhabitants cultivate ſaffron and the cotton tree, but not to any conſiderable advantage. The trade of Baku, though more valuable than that of Derbent, is ſtill conſiderable, and chiefly carried on with Shamakee, from whence it draws raw ſilk and ſilken ſtuffs. A Ruſſian conſul is reſident at this place. In 1777 Baku belonged to Melik-Mehmed, who was tributary to Feth Ali, khan of Kuba; the latter poſſeſſed the whole province of Shirvan, and was the moſt powerful prince, next to the khan of Ghilan, upon the coaſt of the Caſpian. Before we quit the province of Shirvan, it may not be improper to mention its capital, the inland town of Shamakee, which is only 66 miles from Baku, and ſupplies that port with raw ſilk and ſilken ſtuffs. It owed its former commercial importance to the ſilk which is cultivated in the neighbouring diſtrict; this rich production ſtill preſerves the town from ruin; though its traffic is greatly reduced by the exorbitant exactions of the khan of Kuba. Formerly the Ruſſians had a factory at this place; and it was alſo crowded with Turkiſh and Greek merchants; but at preſent there are only a few Armenian and Indian traders. The inhabitants manufacture ſilk and cotton ſtuffs, but far inferior to thoſe made at this place in the beginning of the preſent century. The ſilk of this province is exported into the interior part of Perſia, Turkey, Georgia, and Ruſſia. E. Long. 51. 30. N. Lat. 40. 20.

Balaam. BALAAM, a prophet and diviner of the city of Pethor upon the Euphrates, whoſe practices with Balak king of the Moabites are recorded in the book of Numbers, chap. xxii. It is a queſtion much debated among divines, whether Balaam was a true prophet of God, or no more than a magician or fortune-teller. The Jews indeed are generally of opinion, that he was a buſy and pretending aſtrologer, who, obſerving when men were under a bad aſpect of the ſtars, pronounced a curſe upon them; which ſometimes coming to paſs, gained him in ſome neighbouring nations, a reputation in his way. Several of the ancient fathers ſuppoſe him to be no more than a common ſoothſayer, who undertook to tell future events, and diſcover ſecrets, and by no very juſtifiable arts. Origen will needs have it, that he was no prophet, but only one of the devil's ſorcerers, and that of him he went to inquire; but that God was pleaſed to prevent him and put what anſwers he pleaſed into his mouth. It cannot be denied, however, that the ſcripture expreſsly calls him a prophet (2. Pet. ii. 16.); and therefore ſome later writers have imagined that he had once been a good man and true prophet, till loving the wages of iniquity, and proſtituting the honour of his office to covetouſneſs, he apoſtatiſed from God, and betaking himſelf to idolatrous practices, fell under the deluſion of the devil, of whom he learnt all his magical enchantments, though at this juncture, when the preſervation of his people was concerned, it might be conſiſtent with God's wiſdom to appear to him, and vouchſafe his revelations. As to what paſſed between him and his aſs, when that animal was miraculouſly enabled to ſpeak to its maſter; commentators are divided in their opinions concerning this fact, whether it really and literally happened as Moſes relates it; or whether it be an allegory only, or the mere imagination or viſion of Balaam. This indeed is ſo wonderful an inſtance, that ſeveral of the Jewiſh doctors, who, upon other occaſions are fond enough of miracles, ſeem as if they would hardly be induced to aſſent to this. Philo, in his *Life of Moſes*, paſſes it over in ſilence; and Maimonides pretends that it happened to Balaam in a prophetic viſion only. But St Peter (2 Pet. ii. 16.) ſpeaks of this fact as literal and certain, and ſo all interpreters explain it. St Auſtin, who underſtands it exactly according to the letter, finds nothing in the whole account more ſurpriſing than the ſtupidity of Balaam, who heard his aſs ſpeak to him, and anſwered it as if he talked with a reaſonable perſon. He is of opinion, that this diviner was accuſtomed to prodigies like this, or that he was ſtrangely blinded by his avarice, not to be ſtopped by an event of ſo extraordinary a nature. Le Clerc thinks, that Balaam might probably have imbibed the doctrine of tranſmigration of souls, which was certainly very common in the east; and from thence he might be the less astonished at hearing a brute speak. And Dr Patrick thinks, that Balaam was in such a rage and fury at the supposed perverseness of his beast crushing his foot, that for the present he could think of nothing else; though the conciseness of Moses's relation, who must be presumed to have omitted many circumstances, which if rightly known would dispel this and many more difficulties that may be imagined in this transaction, does certainly furnish us with a better and more satisfactory answer. St Austin is of opinion, that God had not given the ass a reasonable soul; but permitted it to pronounce certain words, in order to reprove the prophet's covetousness. Gregory of Nyssa seems to think that the ass did not utter any word articulately or distinctly; but that, having brayed as usual, the diviner, whose practice it had been to draw presages from the cries of beasts and singing of birds, comprehended easily the ass's meaning by its noise; Moses designing to ridicule this superstitious art of augurs and soothsayers, as if the ass really spoke in words articulate.

We must own, says Calmet, that this is a miraculous fact related by an inspired writer, whose authority we are not allowed to call in question in the least particular: but we should study such ways of explaining it as are most conformable to reason, and most proper to solve the difficulties of it, without attacking the truth of the history. Now it is very possible for God to make an ass speak articulately; it is indeed miraculous, and above the ordinary faculty of this animal, but not against the laws of nature.

BALADAN, the scripture name for a king of Babylon (Isa. xxxix. 1. 2 Kings xx. 12.), called by prophane authors *Belesus* or *Belesis*, *Nabonassar* or *Nanybrus*. Baladan at first was no more than governor of Babylon; but entering into a confederacy with Arbaces governor of Media, and rebelling against Sardanapalus king of Assyria, these two generals marched against him with an army of 400,000 men, and were beat in three different battles. But the Bactrians deserting the king, and coming over to Baladan and Arbaces, the rebels attacked the enemy in the night, and made themselves masters of his camp. After this misfortune, Sardanapalus retreated to Nineveh, and left the command of his army to his brother-in-law Salamenes. The conspirators attacked Salamenes, and defeated him in two great battles; after which they laid siege to Nineveh. Sardanapalus sustained the siege for three years; but the Tigris, in the third year, overflowing its banks, beat down twenty furlongs of the walls; whereupon the conspirators entered the city and took possession of it, after Sardanapalus had burnt himself and all his most valuable effects upon a funeral pile erected for that purpose in his palace. Baladan was acknowledged king of Babylon, as Arbaces was of Media. Berodach-baladan, who sent embassadors to Hezekiah (2 Kings xx.), was the son of Baladan.

BALA, a town of Merionethshire in Wales. W. Long. 3. 37. N. Lat. 52. 54.

BALÆNA, or WHALE, in zoology, a genus of the mammalia class, belonging to the order of cete. The characters of this genus are these: the balæna, in place of teeth, has a horny plate on the upper jaw, and a double fistula or pipe for throwing out water. The species are four, *viz.*

1. The mysticetus, or common whale, which has many turnings and winding in its nostrils, and has no fin on the back. This is the largest of all animals; it is even at present sometimes found in the northern seas 90 feet in length; but formerly they there were taken of a much greater size, when the captures were less frequent, and the fish had time to grow. Such is their bulk within the arctic circle; but in those of the torrid zone, where they are unmolested, whales are still seen 160 feet long. The head is very much disproportioned to the size of the body, being one third the size of the fish: the under lip is much broader than the upper. The tongue is composed of a soft spongy fat, capable of yielding five or six barrels of oil. The gullet is very small for so vast a fish, not exceeding four inches in width. In the middle of the head are two orifices, through which it spouts water to a vast height, and with a great noise, especially when disturbed or wounded. The eyes are not larger than those of an ox, and when the crystalline humour is dried, it does not appear larger than a pea. They are placed towards the back of the head, being the most convenient situation for enabling them to see both before and behind; as also to see over them, where their food is principally found. They are guarded by eye-lids and eye-lashes, as in quadrupeds; and they seem to be very sharp-sighted.

1 Common whale.

2 Description, &c.

Nor is their sense of hearing in less perfection; for they are warned at great distances of any danger preparing against them. It would seem as if nature had designedly given them these advantages, as they multiply little, in order to continue their kind. It is true, indeed, that the external organ of hearing is not perceptible, for this might only embarrass them in their natural element; but as soon as the thin scarf-skin after mentioned is removed, a black spot is discovered behind the eye, and under that is the auditory canal, that leads to a regular apparatus for hearing. In short, the animal hears the smallest sounds at very great distances, and at all times, except when it is spouting water; which is the time that the fishers approach to strike it. What is called *whalebone*, adheres to the upper jaw; and is formed of thin parallel laminæ, some of the longest four yards in length: of these there are commonly 350 on each side, but in very old fish more; about 500 of them are of length fit for use, the others being too short. They are surrounded with long strong hair, not only that they may not hurt the tongue, but as strainers to prevent the return of their food when they discharge the water out of their mouths.—The real bones of the whale are hard, porous, and full of marrow. Two great strong bones sustain the upper lip, lying against each other in the shape of an half-moon.

The tail is broad and semilunar; and when the fish lies on one side, its blow is tremendous. The tail alone it makes use of to advance itself forward in the water; and it is surprising to see with what force and celerity its enormous bulk cuts through the ocean. The fins are only made use of for turning in the water, and giving a direction to the velocity impressed by the tail. The female also makes use of them, when pursued, to bear off her young, clapping them on her back, and supporting

ſupporting them by the fins on each ſide from falling. The whale varies in colour; the back of ſome being red, the belly generally white. Others are black, ſome mottled, others quite white; according to the obſervation of Martin, who ſays, that their colours in the water are extremely beautiful, and that their ſkin is very ſmooth and ſlippery. The outward or ſcarf ſkin of the whale is no thicker than parchment; but this removed, the real ſkin appears, of about an inch thick, and covering the fat or blubber that lies beneath: this is from eight to twelve inches in thickneſs; and is, when the fiſh is in health, of a beautiful yellow. The muſcles lie beneath; and theſe, like the fleſh of quadrupeds, are very red and tough. The penis is eight feet in length, incloſed in a ſtrong ſheath. The teats in the female are placed in the lower part of the belly.

3 Mutual fidelity of the male and female.

In copulation, the female joins with the male, as is aſſerted, *more humano;* and once in two years feels the acceſſes of deſire. Their fidelity to each other exceeds whatever we are told of, even the conſtancy of birds. Some fiſhers, as Anderſon informs us, having ſtruck one of two whales, a male and a female, that were in company together, the wounded fiſh made a long and terrible reſiſtance: it ſtruck down a boat with three men in it, with a ſingle blow of its tail, by which all went to the bottom. The other ſtill attended its companion, and lent it every aſſiſtance; till at laſt, the fiſh that was ſtruck, ſunk under the number of its wounds; while its faithful aſſociate, diſdaining to ſurvive the loſs, with great bellowing, ſtretched itſelf upon the dead fiſh, and ſhared his fate.—

4 Offspring; parental affection, &c.

The whale goes with young nine or ten months, and is then fatter than uſual, particularly when near the time of bringing forth. It is ſaid that the embryo, when firſt preceptible, is about 17 inches long, and white; but the cub, when excluded, is black, and about 10 feet long. She generally produces one young one, and never above two. When ſhe ſuckles her young, ſhe throws herſelf on one ſide on the ſurface of the ſea, and the young one attaches itſelf to the teat.

Nothing can exceed the tenderneſs of the female for her offspring; ſhe carries it with her wherever ſhe goes, and, when hardeſt purſued, keeps it ſupported between her fins. Even when wounded, ſhe ſtill claſps her young one; and when ſhe plunges to avoid danger, takes it to the bottom; but riſes ſooner than uſual, to give it breath again. The young ones continue at the breaſt for a year; during which time, they are called by the ſailors, *ſhort-heads*. They are then extremely fat, and yield above 50 barrels of blubber. The mother at the ſame time is equally lean and emaciated. At the age of two years they are called *ſtunts*, as they do not thrive much immediately after quitting the breaſt: they then yield ſcarce above 20 or 24 barrels of blubber; from that time forward they are called *ſkull-fiſh*, and their age is wholly unknown.

5 Are gregarious.

Every ſpecies of whale propagates only with thoſe of its own kind, and does not at all mingle with the reſt: however, they are generally ſeen in ſhoals, of different kinds together, and make their migrations in large companies from one ocean to another. They are gregarious animals; which implies their want of mutual defence againſt the invaſions of ſmaller, but more powerful, fiſhes. It ſeems aſtoniſhing, therefore, how a ſhoal of theſe enormous animals find ſubſiſtence together, when it would ſeem that the ſupplying even one with food would require greater plenty than the ocean could furniſh. To increaſe our wonder, we not only ſee them herding together, but uſually find them fatter than any other animals of whatſoever element. We likewiſe know that they cannot ſwallow large fiſhes, as their throat is ſo narrow, that an animal larger than an herring could not enter.

6 Their food.

How then do they ſubſiſt and grow ſo fat? A certain ſort of ſmall ſnail, or (as Linnæus ſays) the *meduſa* * or ſea-blubber, is ſufficient for this ſupply. Content with this ſimple food, it purſues no other animal, leads an inoffenſive life in its element, and is harmleſs in proportion to its ſtrength to do miſchief.

7 Inoffenſiveneſs.

8 Enemies.

As the whale is an inoffenſive animal, it is not to be wondered that it has many enemies, willing to take advantage of its diſpoſition, and inaptitude for combat. There is a ſmall animal, of the ſhell-fiſh kind, called the *whale-louſe*, that ſticks to its body, as we ſee ſhells ſticking to the foul bottom of a ſhip. This inſinuates itſelf chiefly under the fins; and whatever efforts the great animal makes, it ſtill keeps its hold, and lives upon the fat, which it is provided with inſtruments to arrive at.

The ſword-fiſh †, however, is the whale's moſt terrible enemy. "At the ſight of this little animal," ſays Anderſon, "the whale ſeems agitated in an extraordinary manner; leaping from the water as if with affright: wherever it appears, the whale perceives it at a diſtance, and flies from it in the oppoſite direction. I have been myſelf," continues he, "a ſpectator of their terrible encounter.

6 Conflict with the ſword-fiſh.

The whale has no inſtrument of defence except the tail: with that it endeavours to ſtrike the enemy; and a ſingle blow taking place, would effectually deſtroy its adverſary: but the ſword-fiſh is as active as the other is ſtrong, and eaſily avoids the ſtroke; then bounding into the air, it falls upon its great ſubjacent enemy, and endeavours not to pierce it with its pointed beak, but to cut with its toothed edges. The ſea all about it is ſeen dyed with blood, proceeding from the wounds of the whale; while the enormous animal vainly endeavours to reach its invader, and ſtrikes with its tail againſt the ſurface of the water, making a report at each blow louder than the noiſe of a cannon." In calm weather, the fiſhermen lie upon their oars as ſpectators of this combat, until they perceive the whale at the laſt gaſp: then they row towards him; and his enemy retiring at their approach, they enjoy the fruits of the victory. This account, however, is different in ſeveral reſpects from that commonly given by ſeamen; who report, that a fiſh called the *Threſher* (a ſpecies of SQUALUS), is in league with the *ſword-fiſh;* and that the former keeps on the back of the whale, while the latter wounds it underneath in the belly, which occaſions him to riſe to the ſurface of the water, and to give the threſher an opportunity of aſſiſting in the combat. This he does by throwing himſelf into an erect poſture; and like a *boy* tumbling neck over heels, falls down with aſtoniſhing force on the back of his prey: And thus they go on till the poor whale is deſtroyed. The grampus, and other large fiſhes of the cetaceous order, are attaked and deſtroyed by the ſame enemies in a ſimilar manner.—The whale has another deſperate enemy, a kind of ſhark, of different ſizes from one to three fathoms; ſo voracious, that it

* See *Meduſa*.

† See *Xiphias*.

tears large pieces of fleſh from the whale, as if they had been dug with ſhovels.

10 Anecdotes of the whale-trade.

To view theſe animals in a commercial light, we muſt obſerve, that the Engliſh were late before they engaged in a whale-fiſhery: it appears by a ſet of queries, propoſed by an honeſt merchant in the year 1575, in order to get information in the buſineſs, that they were at that time totally ignorant of it, being obliged to ſend to *Biſkaie for men ſkilful in the catching of the whale, and ordering of the oil, and one cooper ſkilful to ſet up the ſtaved caſk*. This ſeems very ſtrange; for by the account Octher gives of his travels to King Alfred, near 700 years before that period, it is evident that he made that monarch acquainted with the Norwegians practiſing the whale-fiſhery; but it ſeems all memory of that gainful employ, as well as of that able voyager Octher, and all his important diſcoveries in the north, were loſt for near ſeven centuries.

Hackluyt's Col. of Voy. I. 414.

It was carried on by the Biſcayeners long before the Engliſh attempted the trade; and that for the ſake not only of the oil but alſo of the whalebone, which they ſeem to have long trafficked in. The earlieſt notice we find of that article in their trade is by Hackluyt, who ſays it was brought from the Bay of St Laurence by an Engliſh ſhip that went there for the *barbes* and *fynns* of whales and train oil, A. D. 1594, and who found there 700 or 800 *whale fynnes*, part of the cargo of two great *Biſkaine* ſhips, that had been wrecked there three years before. Previous to that, the ladies ſtays muſt have been made of ſplit cane, or ſome tough wood, as Mr Anderſon obſerves in his Dictionary of Commerce; it being certain that the whale fiſhery was carried on, for the ſake of the oil, long before the diſcovery of the uſe of whalebone.

The great reſort of theſe animals was found to be on the inhoſpitable ſhores of Spitzbergen, and the European ſhips made that place their principal fiſhery, and for numbers of years were very ſucceſsful: the Engliſh commenced that buſineſs about the year 1598, and the town of Hull had the honour of firſt attempting that profitable branch of trade. At preſent it ſeems to be on the decline, the quantity of fiſh being greatly reduced by the conſtant capture for ſuch a vaſt length of time: ſome recent accounts inform us, that the fiſhers, from a defect of whales, apply themſelves to ſeal fiſhery, from which animals they extract an oil. This we fear will not be of very long continuance; for theſe ſhy and timid creatures will ſoon be induced to quit thoſe ſhores by being perpetually harraſſed, as the morſe or walrus has already in a great meaſure done. We are alſo told, that the poor natives of Greenland begin even now to ſuffer from the decreaſe of the ſeal in their ſeas, it being their principal ſubſiſtence; ſo that, ſhould it totally deſert the coaſt, the whole nation would be in danger of periſhing through want.

Pennant's Brit. Zool. 8vo, III. 53. &c.

In old times the whale ſeems never to have been taken on the Britiſh coaſts, but when it was accidentally flung aſhore: it was then deemed a royal fiſh, and the king and queen divided the ſpoil; the king aſſerting his right to the head, her majeſty to the tail.—For the manner of taking whales, ſee *Whale Fishery*.

11 Other ſpecies.

2. The phyſalus, or fin-fiſh, is diſtinguiſhed from the common whale by a fin on the back, placed very low and near the tail. The length is equal to that of the common kind, but much more ſlender. It is furniſhed with whale-bone in the upper jaw, mixed with hairs, but ſhort and knotty, and of little value. The blubber alſo on the body of this kind is very inconſiderable. Theſe circumſtances, added to its extreme fierceneſs and agility, which renders the capture very dangerous, cauſe the fiſhers to neglect it. The natives of Greenland, however, hold it in great eſteem, as it affords a quantity of fleſh which to their palate is very agreeable. The lips are brown, and like a twiſted rope: the ſpout-hole is as it were ſplit in the top of its head, through which it blows water with much more violence, and to a greater height, than the common whale. The fiſhers are not very fond of ſeeing it, for on its appearance the others retire out of thoſe ſeas. Some writers conjecture this ſpecies to have been the Φυσαλος, and *phyſeter*, or blowing-whale of Oppian, Ælian, and Pliny: but ſince thoſe writers have not left the leaſt deſcription of it, it is impoſſible to judge which kind they meant; for in reſpect to the faculty of ſpouting out water, or blowing, it is not peculiar to any one ſpecies, but common to all the whale kind. The phyſalus inhabits the European and American oceans: it feeds upon herrings and other ſmall fiſh.

3. The boops, or pike-headed whale, has a double pipe in its ſnout, three fins like the former, and a hard horny ridge on its back. The belly is full of longitudinal folds or rugæ. It frequents the northern ocean. The length of that taken on the coaſt of Scotland, as remarked by Sir Robert Sibbald, was 46 feet, and its greateſt circumference 20. This ſpecies takes its name from the ſhape of its noſe, which is narrower and ſharper-pointed than that of other whales.

4. The muſculus has a double pipe in its front, and three fins; the under jaw is much wider than the upper one. It frequents the Scotch coaſts, and feeds upon herrings.

Linnæus makes the phyſeter and delphinus, which are ranked among the whales by ſome writers, two diſtinct genera. See Physeter and Delphinus.

BALAGATE, a province of the Mogul empire, and the largeſt of the three that compoſe the kingdom of Dekkan. It has Kandiſh and Barar to the north, Tellinga to the eaſt, Baglana with part of Guzerat to the weſt, and Viſiapur to the ſouth. It is a fruitful and pleaſant country, abounding with cotton and ſugar. Here they have ſheep without horns; but ſo ſtrong, that when bridled and ſaddled they will carry boys of ten years of age. Its preſent capital is Aurengabad, but formerly was Dowlet Abad; and from the latter the whole province is ſometimes called *Dowlet-Abad*.

Balagate Mountains, a chain of mountains which divides the coaſt of Malabar from that of Coromandel, running almoſt the whole length of the peninſula on this ſide the Ganges. Some parts of them are covered with fine red earth, which is blown by the ſtrong weſt winds as far as the iſland of Ceylon; and when the rays of the ſun are reflected from theſe mountains, they ſeem to be all on fire. They make ſurpriſing alterations in the ſeaſons; for on the north ſide of cape Comorin, it is winter in May, June, July, Auguſt, and September, in which months it is ſummer on the ſouth ſide of the cape; on one ſide there are continual tempeſts, thunder and lightning, while the other enjoys a conſtant ſerenity. When black clouds are gathered about

about the mountains, they are followed by sudden rain, which causes the overflowing of the rivers, and choaks them up with sand, insomuch that they are unnavigable for some time afterwards. The buildings and clothes of the inhabitants are scarce sufficient to defend them from the weather. They live upon rice, milk, roots, and herbs, with very little meat: they have likewise a sort of small arrac, but are never given to drunkenness; nor do they import foreign vices, for they never travel abroad.

BALAGNIA, a town of Muscovy, in the province of little Novogorod, seated on the Wolga. E. Long. 45. 5. N. Lat. 50. 36.

BALAGUER, a city of Catalonia in Spain, seated on the north bank of the river Segra, at the foot of a high mountain, on which there was formerly a fortress. E. Long. 0. 48. N. Lat 41. 38.

BALAMBUAN, or PADAMBUAN, a strong town of Asia in the Indies on the east end of the island of Java, and capital of a territory of the same name. E. Long. 115. 30. S. Lat. 7. 50.

BALANCE, or BALLANCE, one of the six simple powers in mechanics, principally used in determining the equality or difference of weights in heavy bodies, and consequently their masses or quantity of matter.

The balance is of two kinds: the ancient and the modern. The ancient or Roman called also the *statera Romana*, or steel-yard, consists of a lever or beam, moveable on a centre, and suspended near one of its extremities; the bodies to be weighed or applied on one side of the centre; and their weight is shown by the division marked on the beam, where the weight, which is moveable along the lever, keeps the steel-yard *in equilibrio*. This balance is still frequently used in weighing heavy bodies.

The modern balance now generally used consists of a lever or beam suspended exactly in the middle, having scales or basons hung to each extremity. The lever is called the *jugum* or *beam*; and the two moieties thereof on each side the axis, the *brachia* or *arms*. The line on which the beam turns, or which divides its brachia, is called the *axis*; and when considered with regard to the length of the brachia, is esteemed a point only, and called the *centre of the balance*; the handle whereby it is held, or by which the whole apparatus is suspended, is called *trutina*; and the slender part perpendicular to the beam, whereby either the equilibrium or preponderancy of bodies is indicated, is called the *tongue* of the balance. Thus in fig. 3. *a b* is the beam, divided into two equal brachia or arms by the white spot in the centre, which is the axis or centre of the balance, and *c* is the tongue. The trutina, on which the axis is suspended, is not represented in this figure, in order to render the other parts more conspicuous.

Plate XCI.

It follows, from what has been observed, therefore, that in the Roman balance, the weight used for a counterpoise is the same, but the point of application varies; in the common balance the counterpoise is various, and the point of application the same. The principle on which each is founded, may be very easily understood from the following observations, and the general properties of the lever. See LEVER.

The beam A B (fig. 6), is a lever of the first kind; but instead of resting on a fulcrum, is suspended by something fastened to its centre of motion: consequently the mechanism of the balance depends on the same theorems as the lever.

Hence as the quantity of matter in known weight is to its distance from the centre of motion, so its distance of the unknown weight to its quantity of matter. Hence the nature and use of the steel-yard is easily known. Let AB (fig. 6.) represent an instrument of this kind; *a*, the trutina or handle on which the beam turns; *k*, a ring on which the balance may be supended on a nail or hook; *f*, the hook on which the body to be weighed is hung; *c*, a collar or guard by which the hook *f* is fastened to the beam; *g*, a moveable collar; *h*, a swivel; *i*, the counterpoise. From what has been said it evidently follows, that if the body to be weighed be fastened to the hook *f*, and the whole supended to the ring *k*, the division on which the counterpoise is placed to maintain an equilibrium in the balance, will show the weight of the body required; provided the weight of the counterpoise *i* be known, and the large divisions, 1, 2, 3, &c. be equal to the distance between the centre of the balance and the screw which fastens the guard *c* to the shorter arm of the balance. It will also be necessary that the steel-yard itself, with its whole apparatus, exclusive of the counterpoise, be *in equilibrio*, when suspended on the ring *k*. If the body to be weighed be heavier than the divisions on the longer arm will indicate, the balance is turned the lower side upwards, and suspended on the other ring *b*; by which means the divisions become shorter, because the distance between the trutina *d*, and the screw on which the guard *c* moves, is less: the divisions in the figure on this side extending to 17, whereas they extend only to 6 on the other. It will be unnecessary perhaps to observe, that the same precaution, with regard to the centre of gravity when the balance is suspended, is also necessary when this side of the balance is used, as we before mentioned with regard to the other.

We have already observed, that in the common scales the two brachia or arms of the balance, *e f*, *e g*, fig. 4. are equal to each other, and consequently equal weights placed in the scales *d d*, will be *in equilibrio* when the balance is suspended on its centre *e*, as in the figure, where the ring at the extremity of the trutina is hung on the tapering rod *a b*, fixed in the foot or basis *c*.

The Deceitful BALANCE, or that which cheats by the inequality of its brachia, is founded on the same principle as the steel-yard. Let there be, for example, a balance so constructed, that both the brachia with their scales should equiponderate, but that the length of the one arm should be to that of the other as 10 to 9. In this case, a weight of nine pounds put into the longest arm, will counterpoise one of ten pounds put into the shorter one: but the cheat is immediately discovered by shifting the weight from one scale to the other; in which case, the balance will no longer remain in *equilibrio*.

Assay-BALANCE, a very nice balance used in docimastical operations, to determine exactly the weight of minute bodies; see fig. 7. This balance should be made of the best steel, and of the hardest kind; because

that

that metal is not so easily spoiled with rust as iron; and it is more apt than any other to take a perfect polish, which at the same time prevents the rust.

The structure of the assayer's scale is little different from that of common scales, otherwise than by its nicety and smallness. The longer the beam of it is, the more exact may the weight of a body be found; however, 10 or 12 inches are a sufficient length. Let the thickness of it be so little, that two drams may hardly be hung at either of its extremities without its bending; for the largest weight put upon it seldom exceeds one dram. The whole surface of this beam must be altogether without ornaments, which only increase the weight and gather dust, &c. The beam is suspended in a fork, the two legs of which are steel springs joined at top, but kept together below with a brass pliant clasp, parallel, and two lines and a half distant from each other. This clasp being taken off, and the legs of the fork being stretched out, the axis of the beam may be put into two holes made for that purpose at the ends of the legs, or be taken away from them. Let a very sharp needle be fixed in the head of the fork, standing perpendicularly downwards, if the fork is suspended, and so long, as that it may almost touch the top of the tongue of the beam put into the fork when in equilibrio. This needle is the mark of the equilibrium; and that the artists may be able to observe this, the legs of the fork must be broader in that place, and have an opening two or three lines wide; this fork may be adorned at pleasure, provided the motion of the balance is not hindered by such ornaments; then take two scales made of thin plate of silver, one inch and a half in diameter, hanging on three small silk strings, almost as long as the beam tied together at top, with a silver hook in form of an S, and hang them to the extremities of the beam: a smaller silver dish or blued steel, somewhat less than one inch in diameter, belongs to each of these scales. You first put into these dishes, with a pair of pincers, the bodies to be weighed, or with a spoon or small shovel, when they are pounded, and then you put them into the scales; therefore the small dishes must be perfectly equal in weight. We use them, that bodies may be more conveniently put into and taken out of the scales, and that these which are vastly thin may not be bent or soiled, and thence rendered false by wiping.

This balance is suspended on a moveable brass or copper support, which consists of a pedestal, and of a column set upon it about 20 inches high, at the top of which comes out at right angles an arm one inch long. At the extremity of this arm, put a small pulley three lines in diameter, another at the top of the column, and a third near the bottom of it; all which pullies must turn very easily on their axes. At the distance of one inch and a half below the upper arm, let another arm one inch and a half long come out of the column at right angles, having a hole through it two lines long, a quarter of a line broad, and placed perpendicularly below the pulley of the upper arm, to receive a small plate, one inch and a half long; and of such breadth and thickness as that it may freely move up and down, and yet not have too much play within the hole. This plate must also have a small hook at each extremity.

And as such a balance will hardly stand still in the open air, and becomes false when spoiled with dust; it must be put, together with its supports, into a small case as represented in fig. 7. having glasses, *a*, *a*, *a*, at top, and all round it, that you may see what is within.

*Manner of using the assay-*BALANCE.—Pass a silk string over the three pullies of the support, and tie it at its upper extremity to the small hook introduced into the hole of the inferior arm; then put the support in the middle of the small case, and pass the other extremity of the silk string below, through a hole bored in the middle of the lower part of the frame, containing the window in the fore part of the case, and fasten it to a small weight of a cubic form. Suspend the fork of the balance on the inferior hook of the plate. By this means if you move backwards and forwards the weight fastened to the string, placed upon the top of the drawer jutting out beyond the fore-part of the case, the balance within is either lifted up or let down. But you must put the bodies to be weighed, and the weights themselves, in the small silver dishes; and these, when loaded, into the scales, thro' the side-windows, which must be opened for that purpose. When any thing is to be added to or taken out of them, you do it with the small pincers; or, if it is powder, with the small shovel or spoon: but you must let the balance down every time any thing is to be added or taken away, that the scales may rest upon the bottom of the case; and shut the windows before the balance is lifted up again, especially if the air is not perfectly calm.

Hydrostatic BALANCE, an instrument contrived to determine accurately the specific gravity of both solid and fluid bodies. It is constructed in various forms; but we shall content ourselves here with describing that which appears of all others the most accurate.

VCG, (fig. 5) is the stand or pillar of this hydrostatic balance, which is to be fixed in a table. From the top A, hangs, by two silk strings, the horizontal bar B B, from which it is suspended by a ring *i*, the fine beam of a balance *b*; which is prevented from descending too low on either side by the gently springing piece *txyz*, fixed on the support M. The harness is annulated at *o*, to show distinctly the perpendicular position of the examen, by the small pointed index fixed above it.

The strings by which the balance is suspended, passing over two pullies, one on each side the piece at A, go down to the bottom on the other side, and are hung over the hook at *v*; which hook, by means of a screw P, is moveable about one inch and a quarter, backward and forward, and therefore the balance may be raised or depressed so much. But if a greater elevation or depression be required, the sliding piece S, which carries the screw P, is readily moved to any part of the square brass rod VK, and fixed by means of a screw.

The motion of the balance being thus adjusted, the rest of the apparatus is as follows. HH is a small board, fixed upon the piece D, under the scales d and e, and is moveable up and down in a low slit in the pillar above C, and fastened at any part by a screw behind. From the point in the middle of the bottom of each scale, hangs, by a fine hook, a brass wire *ad* and *ae*. These pass through two holes *m m* in the table

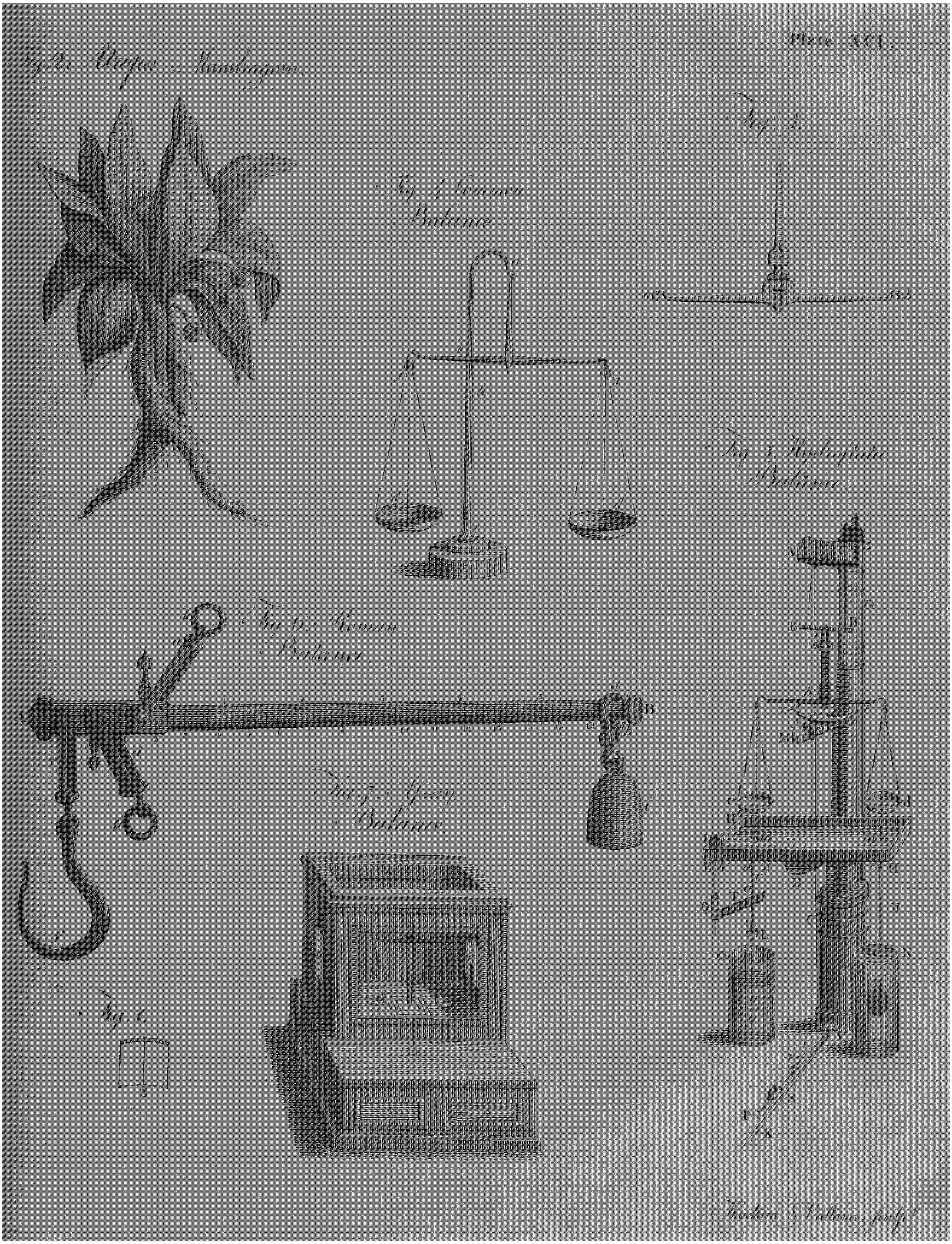


Plate XCI.
Fig. 2. Atropa Mandragora.
Fig. 3.
Fig. 4. Common Balance.
Fig. 5. Hydrostatic Balance.
Fig. 6. Roman Balance.
Fig. 7. Assay Balance.
Fig. 1.
Thackara & Vallance, sculp.

table. To the wire *a d* is suspended a curious cylindric wire, *r s*, perforated at each end for that purpose: this wire *r s* is covered with paper, graduated by equal divisions, and is about five inches long.

In the corner of the board at E, is fixed a brass tube, on which a round wire *h l* is so adapted as to move neither too tight nor too free, by its flat head I. Upon the lower part of this moves another tube Q, which has sufficient friction to make it remain in any position required: to this is fixed an index T, moving horizontally when the wire *h l* is turned about, and therefore may be easily set to the graduated wire *r s*. To the lower end of the wire *r s* hangs a weight L; and to that a wire *p n*, with a small brass ball *g* about one-fourth of an inch diameter. On the other side, to the wire *a c*, hangs a large glass bubble R, by a horse-hair.

Let us first suppose the weight L taken away, and the wire *p n* suspended from S: and, on the other side, let the bubble R be taken away, and the weight F suspended at *c*, in its room. This weight F we suppose to be sufficient to keep the several parts hanging to the other scale in equilibrium; at the same time that the middle point of the wire *p n* is at the surface of the water in the vessel N. The wire *p n* is to be of such a size, that the length of one inch shall weigh four grains.

Now it is evident, since brass is eight times heavier than water, that for every inch the wire sinks in the water it will become half a grain lighter, and half a grain heavier for every inch it rises out of the water: consequently, by sinking two inches below the middle point, or rising two inches above it, the wire will become one grain lighter or heavier. Therefore, if, when the middle point is at the surface of the water in equilibrium, the index T be set to the middle point *a* of the graduated wire *r s*, and the distance on each side *a r* and *a s* contains 100 equal parts; then if, in weighing bodies the weight is required to the hundredth part of a grain, it may be easily had by proceeding in the following manner.

Let the body to be weighed be placed in the scale d. Put the weight X in the scale e; and let this be so determined, that one grain more shall be too much, and one grain less too little. Then the balance being moved gently up or down, by the screw P, till the equilibrium be nicely shown at *o*; if the index T be at the middle point *a* of the wire *r s*, it shows that the weights put into the scale e are just equal to the weight of the body. By this method we find the absolute weight of the body: the relative weight is found by weighing it hydrostatically in water, as follows.

Instead of putting the body into the scale e, as before, let it hang with the weight F, at the hook *c*, by a horse-hair, as at R, supposing the vessel O of water were away. The equilibrium being then made, the index T standing between *a* and *r*, at the 36 division, shows the weight of the body put in to be 1095,36 grains. As it thus hangs, let it be immersed in the water of the vessel O, and it will become much lighter: the scale e will descend till the beam of the balance rest on the support *z*. Then suppose 100 grains put into the scale d restore the equilibrium precisely, so that the index T stand at the 36 division above *a*; it is evident that the weight of an equal bulk of water would, in this case be exactly 100 grains.

After a like manner this balance may be applied to find the specific gravity of liquids as is easy to conceive from what has been said.

Balance of Trade. That which is commonly meant by the balance of trade, is the equal importing of foreign commodities with the exporting of the native. And it is reckoned that nation has the advantage in the balance of trade, which exports more of the native commodities, and imports less of the foreign. The reason of this is, that, if the native commodities be of a greater value than are imported, the balance of that account must be made up in bullion or money: and the nation grows so much richer, as the balance of that account amounts to.

Balance of a Clock, or *Watch,* is that part which regulates the beats. See *Clock-Making.*

Balance-Fish. See Squalus.

BALANCER, in the history of insects, a style, or oblong body, ending in a protuberance or head, found under each wing of the two-winged flies; these serve to poise the body of the fly.

BALANCING, among seamen, the contracting a sail into a narrower compass, in a storm, by retrenching, or folding up a part of it at one corner: this method is used in contradistinction to reefing, which is common to all the principal sails; whereas balancing is peculiar to few, such as the mizen of a ship, and the main-sail of those vessels wherein it is extended by a boom. See Boom and Reef.—The balance of the mizen is thus performed: the mizen yard is lowered a little, then a small portion of the sail is rolled up at the peek or upper corner, and fastened to the yard about one-fifth inward from the outer end or yard-arm toward the mast. See Mizen.—A boom main-sail is balanced, after all its reefs are taken in, by rolling up a similar portion of the hindmost or aftmost lower corner called the *clue*, and fastening it strongly to the boom, having previously wrapped a piece of old canvas round the part (which is done in both cases) to prevent the sail from being fretted by the cord which fastens it.

BALANUS, in zoology, the trivial name of a species of lepas. See Lepas.

BALANSTINES, in botany. See Punica.

BALAYAN, a province of the island of Manila in the East Indies, belonging to the Spaniards.—It lies next to the city of Manila, and extends along the coast on the east side of the island, a little beyond the bay of Batangas. There were formerly gold mines in it, but they have been long since abandoned. It is inhabited by about 2500 tributary Indians, and abounds in cotton, rice, and palm-trees. The province is well cultivated; and the Spaniards, generally speaking, have country-houses in it.

BALBASTRO, a principal town of Spain, in the kingdom of Arragon, and capital of a district of the same name. E. Long. 0. 20. N. Lat. 41. 50.

BALBEC, a city of Asia in Syria, anciently called *Heliopolis*, and by the Arabians the *wonder of Syria.* It is situated at the foot of Anti-Lebanon, precisely on the last rising ground where the mountain terminates in the plain. As we arrive from the south we dis-

Balbec. discover the city only at the distance of a league and a half, behind a hedge of trees over the verdant tops of which appears a white edging of domes and minarets. After an hour's journey we reach these trees, which are very fine walnuts; and soon after, crossing some ill-cultivated gardens, by winding paths, arrive at the entrance of the city. We there perceive a ruined wall flanked with square towers, which ascends the declivity to the right, and traces the precincts of the ancient city. This wall, which is only ten or twelve feet high, permits us to have a view of those void spaces and heaps of ruins which are the invariable appendage of every Turkish city; but what principally attracts our attention is a large edifice on the left, which, by its lofty walls and rich columns, manifestly appears to be one of those temples which antiquity has left for our admiration. These ruins, which are some of the most beautiful and best preserved of any in Asia, merit a particular description.

To give a just idea of them, we must suppose ourselves descending from the interior of the town. After having crossed the rubbish and huts with which it is filled, we arrive at a vacant place which appears to have been a square; there, in front, towards the west, we perceive a grand ruin, which consists of two pavilions ornamented with pilasters, joined at their bottom angle by a wall 160 feet in length. This front commands the open country from a sort of terrace, on the edge of which we distinguish with difficulty the bases of twelve columns, which formerly extended from one pavilion to the other and formed a portico. The principal gate is obstructed by heaps of stones; but, that obstacle surmounted, we enter an empty space, which is an hexagonal court of 180 feet diameter. This court is strewed with broken columns, mutilated capitals, and the remains of pilasters, entablatures, and cornices; around it is a row of ruined edifices which display all the ornaments of the richest architecture. At the end of this court, opposite the west is an outlet, which formerly was a gate through which we perceive a still more extensive range of ruins, whose magnificence strongly excites curiosity. To have a full prospect of these, we must ascend a slope, up which were the steps to this gate; and we then arrive at the entrance of a square court, much more spacious than the former, being 350 wide and 336 in length. The eye is at first attracted by the end of this court, where six enormous and majestic columns render the scene astonishingly grand and picturesque. Another object not less interesting is a second range of columns to the left, which appear to have been part of the peristyle of a temple; but before we pass thither, we cannot refuse particular attention to the edifices which inclose this court on each side. They form a sort of gallery which contains various chambers, seven of which may be reckoned in each of the principal wings, viz. two in a semicircle and five in an oblong square. The bottom of these apartments still retains pediments of niches and tabernacles, the supporters of which are destroyed. On the side of the court they are open, and present only four and six columns totally destroyed. It is not easy to conceive the use of these apartments; but this does not diminish our admiration at the beauty of their pilasters and the richness of the frize of the entablature. Neither is it possible to avoid remarking the singular effect which results from the mixture of the garlands, the large foliage of the capitals, and the sculpture of wild plants with which they are every where ornamented. In traversing the length of the court, we find in the middle a little square esplanade, where was a pavilion, of which nothing remains but the foundation. At length we arrive at the foot of the six columns; and then first conceive all the boldness of their elevation and the richness of their workmanship. Their shafts are 21 feet eight inches in circumference and 58 high; so that the total height, including the entablature, is from 71 to 72 feet. The sight of this superb ruin, thus solitary and unaccompanied, at first strikes us with astonishment; but, on a more attentive examination, we discover a series of foundations which mark an oblong square of 268 feet in length and 146 wide, and which, it seems probable, was the peristyle of a grand temple, the primary purpose of this whole structure. It presented to the great court, that is to the east, a front of ten columns, with 19 on each side, which with the other six make in all 54. The ground on which it stood was an oblong square, on a level with this court, but narrower than it, so that there was only a terrace of 27 feet wide round the colonnade; the esplanade this produces fronts the open country toward the west, by a sloping wall of about 30 feet. This descent as you approach the city becomes less steep, so that the foundation of the pavilion is on a level with the termination of the hill; whence it is evident that the whole ground of the courts has been artificially raised. Such was the former state of this edifice; but the southern side of the grand temple was afterwards blocked up to build a smaller one, the peristyle and walls of which are still remaining. This temple, situated somewhat lower than the other, presents a side of 13 columns by eight in front (in all 34), which are likewise of the Corinthian order; their shafts are 15 feet eight inches in circumference, and 44 in height. The building they surround is an oblong square, the front of which, turned towards the east, is out of the line of the left wing of the great court. To reach it you must cross trunks of columns, heaps of stone, and a ruinous wall by which it is now hid. After surmounting these obstacles you arrive at the gate, where you may survey the inclosure which was once the habitation of a god; but instead of the awful scene of a prostrate people and sacrifices offered by a multitude of priests, the sky, which is open from the falling in of the roof, only lets in light to show a chaos of ruins covered with dust and weeds. The walls, formerly enriched with all the ornaments of the Corinthian order, now present nothing but pediments of niches and tabernacles, of which almost all the supporters are fallen to the ground. Between these niches is a range of fluted pilasters, whose capitals support a broken entablature; but what remains of it displays a rich frize of foliage resting on the heads of satyrs, horses, bulls, &c. Over this entablature was the ancient roof, which was 57 feet wide and 110 in length. The walls which supported it are 31 feet high, and without a window. It is impossible to form any idea of the ornaments of this roof, except from the fragments lying on the ground; but it could not have been richer

Balbec.

richer than the gallery of the periſtyle: the principal remaining parts contain tablets in the form of lozenges, on which are repreſented Jupiter ſeated on his eagle; Leda careſſed by the ſwan; Diana with her bow and creſcent; and ſeveral buſts which ſeem to be figures of emperors and empreſſes. It would lead us too far to enter more minutely into the deſcription of this aſtoniſhing edifice. The lovers of the arts will find it deſcribed with the greateſt truth and accuracy in a work publiſhed at London in 1757 under the title of *Ruins of Balbec.* This work, compiled by Mr Robert Wood, the world owes to the attention and liberality of Mr Dawkins, who in 1751 viſited Balbec and Palmyra. But ſeveral changes, however, have taken place ſince their journey: for example, they found nine large columns ſtanding, and in 1784 Mr Volney found but ſix. They reckoned 29 at the leſſer temple, but there now remain but 20; the others have been overthrown by the earthquake of 1759. It has likewiſe ſo ſhaken the walls of the leſſer temple, that the ſtone of the ſoffit, or croſs ſtone at the top, of the gate was ſlid between the two adjoining ones, and deſcended eight inches; by which means the body of the bird ſculptured on that ſtone is ſuſpended detached from its wings and the two garlands which hung from its beak and terminated in two genii. Nature alone has not effected this devaſtation; the Turks have had their ſhare in the deſtruction of the columns. Their motive is to procure the iron cramps, which ſerve to join the ſeveral blocks of which each column is compoſed. Theſe cramps anſwer ſo well the end intended, that ſeveral of the columns are not even disjointed by their fall; one, among others, as Mr Wood obſerves, has penetrated a ſtone of the temple wall without giving way; nothing can ſurpaſs the workmanſhip of theſe columns; they are joined without any cement, yet there is not room for the blade of a knife between their interſtices. After ſo many ages, they in general ſtill retain their original whiteneſs. But what is ſtill more aſtoniſhing, is the enormous ſtones which compoſe the ſloping wall. To the weſt the ſecond layer is formed of ſtones which are from 28 to 35 feet long, by about nine in height. Over this layer, at the north-weſt angle, there are three ſtones which alone occupy a ſpace of 175½ feet; viz. the firſt 58 feet ſeven inches: the ſecond 58 feet 11, and the third exactly 58 feet; and each of theſe are 12 feet thick. Theſe ſtones are of a white granite, with large ſhining flakes like gypſe; there is a quarry of this kind of ſtone under the whole city and in the adjacent mountain, which is open in ſeveral places, and among others on the right, as we approach the city. There is ſtill lying there a ſtone, hewn on three ſides, which is 69 feet two inches long, 12 feet 10 inches broad, and 13 feet three in thickneſs. By what means could the ancients move theſe enormous maſſes? This is doubtleſs a problem in mechanics curious to reſolve. The inhabitants of Balbec have a very commodious manner of explaining it, by ſuppoſing theſe edifices to have been conſtructed by *Djenoun*, or genii, who obeyed the orders of King Solomon; adding, that the motive of ſuch immenſe works was to conceal in ſubterraneous caverns vaſt treaſures, which ſtill remain there. To diſcover theſe, many have deſcended into the vaults which range under the whole edifice; but the inutility of their reſearches, added to the oppreſſions and extortions of the governors, who have made their ſuppoſed diſcoveries a pretext, have at length diſheartened them; but they imagine the Europeans would be more ſucceſsful, nor would it be poſſible to perſuade them but what we are poſſeſſed of the magic art of deſtroying taliſmans. It is in vain to oppoſe reaſon to ignorance and prejudice: and it would be no leſs ridiculous to attempt to prove to them that Solomon never was acquainted with the Corinthian order, which was only in uſe under the Roman emperors. But their tradition on the ſubject of this prince may ſuggeſt three important obſervations. Firſt, That all tradition relative to high antiquity is as falſe among the Orientals as the Europeans. With them, as with us, facts which happened 100 years before, when not preſerved in writing, are altered, mutilated, or forgotten. To expect information from them with reſpect to events in the time of David or Alexander, would be as abſurd as to make inquiries of the Flemiſh peaſants concerning Clovis or Charlemagne. Secondly, That throughout Syria, the Mahometans, as well as the Jews and Chriſtians, attribute every great work to Solomon: not that the memory of him ſtill remains by tradition in thoſe countries, but from certain paſſages in the Old Teſtament; which, with the goſpel, is the ſource of almoſt all their tradition, as theſe are the only hiſtorical books read or known; but as their expounders are very ignorant, their applications of what they are told are generally very remote from truth: by an error of this kind they pretend Balbec is *the houſe of the foreſt of Lebanon* built by Solomon; nor do they approach nearer probability when they attribute to that king the well of Tyre and the buildings of Palmyra. Thirdly, That the belief in hidden treaſures has been confirmed by diſcoveries which have been really made from time to time. It is not many years ſince a ſmall coffer was found at Hebron full of gold and ſilver medals, with an ancient Arabic book on medicine. In the country of the Druzes an individual diſcovered likewiſe, ſome time ſince, a jar with gold coin in the form of a creſcent; but as the chiefs and governors claim a right to theſe diſcoveries, and ruin thoſe who have made them, under pretext of obliging them to make reſtoration, thoſe who find any thing endeavour carefully to conceal it; they ſecretly melt the antique coins, nay, frequently bury them again in the ſame place where they found them, from the ſame fears which cauſed their firſt concealment, and which prove the ſame tyranny formerly exiſted in theſe countries.

When we conſider the extraordinary magnificence of the temple of Balbec, we cannot but be aſtoniſhed at the ſilence of the Greek and Roman authors. Mr Wood, who has carefully examined all the ancient writers, has found no mention of it except in a fragment of John of Antioch, who attributes the conſtruction of this edifice to Antoninus Pius. The inſcriptions which remain corroborate this opinion, which perfectly accounts for the conſtant uſe of the Corinthian order, ſince that order was not in general uſe before the third age of Rome; but we ought by no means to allege as an additional proof the bird ſculptured over the gate; for if his crooked beak, large claws, and the

the caduceus he bears, give him the appearance of an eagle, the tuft of feathers on his head, like that of certain pigeons, proves that he is not the Roman eagle: besides that the same bird is found in the temple of Palmyra; and is therefore evidently an Oriental eagle, consecrated to the sun, who was the divinity adored in both these temples. His worship existed at Balbec in the most remote antiquity. His statue, which resembled that of Osiris, had been transported there from the Heliopolis of Egypt, and the ceremonies with which he was worshipped there have been described by Macrobius, in his curious work entitled *Saturnalia*. Mr Wood supposes with reason, that the name of Balbec, which in Syriac signifies *City of Bal*, or of the sun, originated in this worship. The Greeks, by naming it *Heliopolis*, have in this instance only given a literal translation of the oriental word; a practice to which they have not always adhered. We are ignorant of the state of this city in remote antiquity; but it is to be presumed, that its situation, on the road from Tyre to Palmyra, gave it some part of the commerce of these opulent capitals. Under the Romans, in the time of Augustus, it is mentioned as a garrison town; and there is still remaining, on the wall of the southern gate, on the right as we enter, an inscription which proves the truth of this, the words KENTURIA PRIMA, in Greek characters, being very legible. One hundred and forty years after, Antoninus built there the present temple, instead of the ancient one, which was doubtless falling into ruins: but Christianity having gained the ascendency under Constantine, the modern temple was neglected, and afterwards converted into a church; a wall of which is now remaining, that hid the sanctuary of the idols. It continued thus until the invasion of the Arabs, when it is probable, they envied the Christians so beautiful a building. The church being less frequented fell to decay; wars succeeded; and it was converted into a place of defence; battlements were built on the wall which surrounded it, on the pavilions and at the angles, which still subsist; and from that time, the temple, exposed to the fate of war, fell rapidly to ruin. The state of the city is not less deplorable. The wretched government of the emirs of the house of Harfoushe had already greatly impared it, and the earthquake of 1759 completed its destruction. The wars of the Emir Yousef and Djezzar have rendered it still more deserted and ruinous. Of 5000 inhabitants, at which number they were estimated in 1751, not 1200 are now remaining; and all these poor, without industry or commerce, and cultivating nothing but a little cotton, some maize, and water-melons.

BALBINUS (Decimus Cœlius), the Roman emperor, being chosen by the senate in 237, was massacred by the soldiers, who had a dislike to such emperors as were elected only by the senators. This prince was eloquent, and wrote pretty good verses.

BALBOA (Vasco Nugnes de), a Castilian; a celebrated navigator, and one of the first discoverers of South America. He was beheaded by the Spanish governor of St Mary, through jealousy of his growing reputation, in 1517, aged 42.

BALBUS (Lucius Cornelius Theophanes), was born at Cadiz, and distinguished himself by his valour in the war carried on by the Romans in Spain against Sertorius and the Lusitanians; on which account Pompey gave him the privileges of a Roman citizen. He was consul in the 714th year of Rome, and was the first foreigner on whom that dignity was conferred. He was the friend of Pompey, Cæsar, Crassus, and Cicero.—There were many other illustrious Romans of the name of *Balbus*.

BALCONY, in architecture, a projecture in the front of a house, or other building, supported by pillars or consoles, and encompassed with a balustrade.

BALDACHIN, or BALDAQUIN, in architecture, a building in form of a canopy, supported by pillars, and frequently used as a covering to insulated altars. Some also use the term *baldachin* for the shell over a door.

BALDINUCCI (Philip), of Florence; a connoisseur in the polite arts, and the continuator of Vasar's lives of the painters. He died in 1696, aged 72.

BALDIVIA, or VALDIVIA, a sea-port town of Chili, in America, belonging to the Spaniards. It is situated between the rivers Callaculles and Portero, where they fall into the South Sea. W. Long. 80. 5. S. Lat. 40. 5. It was built in 1551 by the Spanish general Baldivia, from whom it takes its name. We may judge of its importance from the sum granted annually by the king for maintaining the garrison and keeping the fortifications in repair, being no less than 300,000 pieces of eight. It is defended by four strong castles, mounting 100 pieces of fine brass cannon. Notwithstanding which, however, as the garrison is composed mostly of transported criminals, on whom no dependance can be placed, and generally ill supplied with ammunition, &c. it could make but a poor defence. In 1643 it was easily taken by the Dutch, who would probably have maintained their conquest against all the power of the Spanish viceroy, had they not been obliged to relinquish it through sickness and famine. The inhabitants of Baldivia amount to about 2000. The trade is less considerable than formerly, because the gold mines in the neighbourhood are shut up; yet several large ships are employed in the trade between this port and that of Lima, which consists of gold, corn, hides, and salt provisions, which are exchanged for slaves, sugar, chocolate, and European commodities and manufactures.

BALDNESS, a defect of hair, chiefly on the sinciput. It differs from *alopecia*, *area*, *ophiasis*, and *tinea*, as these all arise from some vice in the nutritious humour; *baldness*, from the defect of it. When the eyelids shed their hair, it is called a *ptilosis*. Among the causes of baldness, immoderate venery is reputed one of the chief: old age usually brings it on of course. Some will have the proximate cause of baldness to be the dryness of the brain, and its shrinking from the cranium; it having been observed, that in bald persons there is always a vacuity or empty space between the skull and the brain.—*Calvus*, *bald-pate*, was a frequent term of reproach among the Romans; among whom this defect was in great discredit. Hence divers arts to conceal it, as false hair, a *galericulus* contrived on purpose. The later Romans, however, seem to have been recon-

reconciled to baldneſs; for we find among them a kind of officers, or ſervants, called *glabratores*, or *glabrarii*, whoſe buſineſs was to take off the hair from all parts, even from the head. In an ancient inſcription, there is mention of one Diophantus, TI. CÆSARIS ORNATOR GLABR. that is, *Ornator Glabrarius*.

BALDOC, a town of Hertfordſhire, in England, chiefly noted for its trading in malt. W. Long. 0. 10. N. Lat. 51. 55.

BALDOCK (Ralph de), biſhop of London in the reigns of Edward I. and II. was educated at Moreton-college, in Oxford; became dean of St Paul's; was afterwards promoted to the ſee of London; and at laſt was made lord high chancellor of England. He had a very amiable character both for morals and learning; and wrote *Hiſtoria Anglica*, or An Hiſtory of the Britiſh Affairs down to his own time; and, A Collection of the Statutes and Conſtitutions of the church of St Paul. Biſhop Baldock died at Stepney, July 24. 1313.

BALDWIN, archbiſhop of Canterbury, was born of obſcure parents at Exeter, where in the early part of his life, he taught a grammar-ſchool; after which he took orders, and was made archdeacon of Exeter: but he reſigned that dignity, and became a Ciſtertian monk in the monaſtery of Ford in Devonſhire, of which in a few years he was made abbot. In the year 1180, he was conſecrated Biſhop of Worceſter. In 1184, he was promoted to the ſee of Canterbury by Pope Lucius III. and, by his ſucceſſor Urban III. was appointed legate for that dioceſe. He laid the foundation of a church and monaſtery in honour of Thomas Becket, at Hackington, near Canterbury, for ſecular prieſts; but, being oppoſed by the monks of Canterbury and the Pope, was obliged to deſiſt. In 1190 he crowned King Richard I. at Weſtminſter; and ſoon after followed that prince to the holy land, where he died at the ſiege of Ptolemais. Giraldus Cambrenſis, who accompanied him in this expedition, ſays he was of a mild diſpoſition, and of great abſtinence. He wrote various tracts on religious ſubjects, which were collected and publiſhed by Bertrand Tiſſier in 1662.

BALE (John), biſhop of Oſſory in Ireland, was born at Cove, near Dunwich in Suffolk, in the year 1495. At 12 years of age he was entered in the monaſtery of Carmelites at Norwich, and was thence ſent to Jeſus-college in Oxford. He was educated a Roman catholic, but was converted to the Proteſtant religion by Thomas Lord Wentworth. On the death of Lord Cromwell, favourite of Henry VIII. who protected him from the perſecutions of the Romiſh clergy, he was obliged to retire into the Low Countries, where he continued eight years. Soon after the acceſſion of Edward VI. he was recalled; and being firſt preſented to the living of Biſhop's Stocke in Hampſhire, in 1552, he was nominated to the ſee of Oſſory. During his reſidence in Ireland he was remakably aſſiduous in propagating the Proteſtant doctrines; but to very little purpoſe, and frequently at the hazard of his life. Once, in particular, they murdered five of his domeſtics, who were making hay in a meadow near his houſe; and would probably have done the ſame by him, if the ſovereign of Kilkenny had not come to his aſſiſtance with 100 horſe and 300 foot. On the acceſſion of Queen Mary, the tide of oppoſition became ſo powerful, that, to avoid aſſaſſination, he embarked for Holland, but was very unfortunate in his eſcape. Firſt he was taken by a Dutch man of war, and robbed by the captain of all his effects. Then, being forced by ſtreſs of weather into St Ive's in Cornwall, he was confined on ſuſpicion of treaſon. Being however releaſed after a few days confinement, the ſhip anchored in Dover road, where he was again ſeized on a falſe accuſation. After his arrival in Holland, he was kept priſoner for three weeks, and at length obtained his liberty on paying 30 l. From Holland he travelled to Baſil in Switzerland, where he continued till Queen Elizabeth aſcended the throne. After his return to England, he was in 1560 made prebendary of Canterbury, probably not chooſing to return to his former flock of wolves. He died in November 1563, at Canterbury, in the 68th year of his age. He was ſo ſevere a writer againſt the church of Rome, that his books are particularly prohibited in the expurgatory index publiſhed at Madrid, in folio, in the year 1667. He is the earlieſt dramatic writer in the Engliſh language, or at leaſt author of the firſt pieces of that kind that we find in print. Of his writings in that way no fewer than 21 have been enumerated; only three of them, however, have been ſeen in print, *viz.* 1. God's Promiſes, an interlude; 2. St John Baptiſt, an interlude; 3. Concerning the Laws of Nature corrupted: the firſt of which has been reprinted by Dodſley in the firſt volume of his collection of old plays, and the only copy extant of the laſt is preſerved in St Sepulchre's library in Dublin. As to the reſt, they are mentioned by himſelf, as his own, in his account of the writers of Britain before mentioned. He alſo tranſlated the tragedies of Pammachius. His other works are very numerous; but the chief is his catalogue of Britiſh Authors: a book of ſome merit, as it contains ſome information which is not elſewhere to be found; but he has deſtroyed his credit by his intemperate Billingſgate abuſe of all thoſe who differed from him in religion. The authentic part of his work is tranſcribed from Leland. The title of it is, *Illuſtrium Majoris Britanniæ ſcriptorum catalogus, a Japheto ſanctiſſimi Noa filio ad an. Dom.* 1557.

BALE, in commerce. Any goods packed up in cloth, and corded round very tight, in order to keep them from breaking, or preſerve them from the weather, is called *a bale*.—A bale of cotton yarn is from 300 to 400 weight; of raw ſilk, is from 100 to 400; of lockram or dowlas, either three, three and a half, or four pieces.

BALE-goods, among the Engliſh merchants are, all ſuch as are imported or exported in bales; but the French give that name to certain hardwares, and other ſorts of merchandize, which come to Paris, and are commonly made by bad workmen of indifferent materials.

BALEARES INSULÆ, or the *Balearic Iſlands*. The apellation is commonly derived from Βαλλειν, becauſe the inhabitants were excellent ſlingers. But Bochart makes the name of Punic or Phœnician original, as were the people: *Baal-jare*, a maſter, or ſkilful at throwing; the Phœnicians and Hebrews being dexterous at the uſe of the ſling. The Greeks called theſe iſlands *Gymneſiae* (Strabo); becauſe in ſummer the inhabitants went naked (Diodorus, Livy), or rather

ther becaufe only armed with a fling in war (Hefychius). They are two in number, the Greater and the Lefs, or Major and Minor; and hence the modern names *Majorca* and *Minorca*. The Major is diftant from the Minor 30 miles to the weft, in length 40 miles, and in circuit 150 (Pliny). They were fubdued by Quintus Metellus, thence furnamed *Balearicus*, in the year 120 B. C. The Baleares, together with the adjacent iflands, were a part of the Provincia Citerior or Tarraconenfis, and of the refort of the Conventus Carthaginienfis of New Carthage. Thefe iflands are called *Choearades* by Apollonius, and *Choeradades* by Strabo, *i. e.* " rocky." See Majorca and Minorca.

BALEARIC islands. See the preceding article.

BALECHOU (John Jofeph), a very celebrated and well known French engraver, flourifhed about 1750. He died, according to Bafan, fome few years fince at Avignon. This extraordinary artift worked entirely with the graver; and he was perfectly mafter of that inftrument. The clearnefs of his ftrokes, and the depth of colour which he produced, are far beyond any production prior to his own. The two large plates which he did from Vernet, one reprefenting a *ftorm*, the other a *calm*, muft ever be confidered as very aftonifhing exertions of the artift. They are too well known, and too much admired, to need any further eulogium; and were never equalled, until they were perhaps furpaffed by an Englifhman, Mr Woollet.

BALEN (Hendrick Van), hiftory and portrait painter, was born at Antwerp, in 1560, and was a difciple of Adam Van Oort; but he quitted that mafter to acquire a better tafte of defign and compofition, by purfuing his ftudies at Rome, where he refided for a confiderable time. He copied the antiques; he attended to the works of the moft memorable modern artifts; and at his return to his own country, the vifible improvement of his tafte recommended him to the favour and efteem of the ableft judges of the art. He diftinguifhed himfelf by a good manner of defigning, and his works are admitted into the cabinets of the curious, among thofe of the principal painters. He particularly excelled in the naked, and gave to his figures fo much truth, roundnefs, and correctnefs of outline, that few of his cotemporaries could enter into competition with him. Several fine portraits of his hand are at the Hague; among which there is one adorned with allegorical figures of Wifdom and Juftice, which extorts commendation from all who attentively confider it. He died in 1632. All the hiftorical fubjects painted by Van Balen have abundant merit. His defigns of the Deluge, of Mofes ftriking the Rock, and the drowning of Pharaoh, are grand and noble compofitions. Houbraken obferves, that Van Balen, with great judgment, hath introduced the Ifraelites in a clear light in the back-ground, but the Egyptians in a ftrong fhadow in the fore-ground, which had a very fine effect; the figures being well defigned, the attitudes and draperies well chofen, and the number of the figures being very confiderable. Of this painter's hand alfo, the judgment of Paris is accounted a mafterly performance; in which the figure of Venus is fo elegantly defigned, fo full of life, and fo round, that it feems to ftand forth from the furface. The landfcapes and back-grounds of the pictures compofed by Van Balen, were generally painted by the Velvet Breughel.

BALEN (John Van), painter of hiftory, landfcapes, and boys, was born at Antwerp in 1611; and derived his knowledge of the art, and his fine tafte of drawing and defign, from his father Hendrick Van Balen; but, as foon as he had made a competent progrefs, he travelled to Rome, and lived for feveral years in that and other cities of Italy. There he acquired a good gufto of defign, though he was fometimes incorrect; and his particular merit was fhown in his naked figures of boys, cupids, nymphs bathing or hunting, of which fubjects he painted a confiderable number; and he procured both praife and riches by his landfcapes and hiftories. His pictures were well handled, his trees touched with fpirit, and his herbage and verdure looked natural and lively. The carnations of his figures were clear and frefh; his colouring in general was tranfparent; and the airs of his heads were in the manner of Albano.

BALES (Peter), a very extraordinary perfon in his way, and fit to be recorded in a work of this nature. He was a moft famous mafter in the art of Penmanfhip, or fair writing; and one of the firft inventors (for there feems to have been more than one) of fhort-hand writers. He was born in 1547, and is ftyled by Anthony Wood " a moft dexterous perfon in his profeffion, to the great wonder of fcholars and others:" who adds, that " he fpent feveral years in fciences among the Oxonians, particularly as it feems in Gloucefter hall: but that ftudy, which he ufed for a diverfion only, proved at length an employment of profit." He is recorded for his fkill in micrography, or miniature-writing, in Hollinfhed's Chronicle, anno 1575; and Mr Evelyn alfo hath celebrated his wonderful fkill in this delicate operation of the hand. " Hadrian Junius fpeaking as a miracle of fomebody, who wrote the Apoftle's Creed, and the beginning of St John's Gofpel, within the compafs of a farthing; what would he have faid," fays Mr Evelyn, " of our famous Peter Bales; who in the year 1575, wrote the Lord's Prayer, the Creed, Decalogue, with two fhort prayers in Latin, his own name, motto, day of the month, year of the Lord, and reign of the Queen, to whom he prefented it at Hampton Court, all of it written within the circle of a fingle penny, inchafed in a ring and borders of gold; and covered with a chryftal fo accurately wrought, as to be very plainly legible, to the great admiration of her Majefty, the whole Privy Council, and feveral ambaffadors then at Court?" He was farther very dexterous in imitating hand-writing, and, about 1586, was employed by Secretary Walfingham in certain political manœuvres. We find him at the head of a fchool, near the Old Bailey, London, in 1590; in which year he publifhed his " Writing Schoolmafter, in three parts: the firft teaching fwift writing, the fecond, true writing, the third, fair writing." In 1595, he had a great trial of fkill in the Black-friars with one Daniel Johnfon, for a golden pen of 20 l. value, and won it; and a contemporary author farther relates, that he had alfo the arms of Caligraphy given him, which are Azure, a Pen, Or, as a prize, at a trial of fkill in this art among the beft penmen in London. In 1597, he republifhed his " Writing Schoolmafter,"

Schoolmafter," which was in fuch high reputation, that no lefs than eighteen copies of commendatory verfes, compofed by learned and ingenious men of that time, were printed before it. Wood fays, that he was engaged in Effex's treafons in 1600; but Wood was miftaken: he was only engaged, and very innocently fo, in ferving the treacherous purpofes of one of that Earl's mercenary dependents. We know little more of this curious perfon, but that he feems to have died about the year 1610.

BALESTRA (Antonio), an excellent hiftorical painter, was born at Verona in 1666. At the age of 21 he went to Venice, where he entered himfelf in the fchool of Antonio Bellucci, and continued for three years under his direction; but from thence he vifited Bologna and Rome, and at the latter became the difciple of Carlo Maratti. Under the tuition of fo eminent a genius, he made a very great proficiency, and exerted himfelf for fome hours of each day, in defigning after the antiques, after Raphael, Correggio, Annibal Carracci and other admired painters; by which conduct he fo effectually confirmed his tafte and freedom of hand, that he obtained the prize of merit in the academy of St Luke, in the year 1694, when he was only 28 years of age. From that time his reputation was eftablifhed, and he received fufficient encouragement; being engaged to work for moft of the churches, and in the palaces of the nobility, and his paintings were admired in every part of Europe. His ftyle is fweet and agreeable, not unlike that of Maratti; and the judicious obferve in the works of Baleftra, a certain mixture of the feveral manners of Raphael, Correggio, and Carracci. He died in 1740. In the Church of Santa Maria Mater Domini at Venice, there is one of the moft capital performances of Baleftra, reprefenting the nativity of our Saviour. It is defigned in a grand ftyle, the compofition is excellent, and has a great deal of grace. The heads are peculiarly fine; and the whole has a noble effect, with remarkable harmony. In a chapel belonging to the church of S. Geminiano, in the fame city, there is a dead Chrift in the arms of the Virgin, painted by this mafter in a grand tafte; and although the compofition confifts but of a few figures, they are finely defigned; and in every part of it there is a fufficient merit to claim and juftify applaufe.

BALEY (Walter), the fon of Henry Baley of Warnwell in Dorfetfhire, was born at Potfham in the fame county, and educated at Winchefter fchool. From thence he was fent to Oxford; and, after two years probation, was admitted perpetual fellow of New College in the year 1550. Having taken his degrees in arts, he practifed phyfic, and in 1558 was proctor of the univerfity. About this time he obtained a prebend of Wells, which he refigned in 1579. In the year 1561 he was appointed queen's profeffor of phyfic, in 1563 proceeded doctor in that Faculty, and afterwards became one of her majefty's phyficians in ordinary. He was thought fkilful in his profeffion, and had confiderable practice. He died in 1592, aged 63; and was buried in the inner chapel of New College. His works are, 1. *A difcourfe of three kinds of pepper in common ufe*, 1588, 8vo. 2. *Brief treatife of the prefervation of the eye-fight*. Firft printed in the reign of Elizabeth, in 12mo; afterwards at Oxford in 1616 and 1654, 8vo. 3. *Directions for health, natural and artificial; with medicines for all difeafes of the eyes*, 1626, 4to. 4. *Explicatio Galeni de potu convalafcentium et fenum*, &c. manufcript, formerly in Lord Aylefbury's library.

BALI, an ifland of Afia, in the Eaft-Indies, forming the north fide of the ftraits of Java, through which the Eaft-India fhips fometimes return from China to Europe: but the paffage is commonly difficult on account of contrary winds. The ifland is extremely populous, and abounds in rice and other productions proper to the climate. The inhabitants are Pagans, and very warlike. E. Long. 115. 30. S. Lat. Lat. 9. 0.

BALIOL, or Balliol, (Sir John de), founder of Baliol-college, in Oxford, was the fon of Hugh Baliol, of Bernard's caftle, in the diocefe of Durham; and was a perfon very eminent for his power and riches. During the contefts and wars between King Henry III. and his barons, he firmly adhered to the king. In 1263, he began the foundation and endowment of Baliol-college, which was afterwards perfected by his widow. He died in the year 1269.

Baliol, Balliol, or Boilliol, (John), the brother of Alexander king of Scotland, and competitor with Robert Bruce for that crown. See Scotland.

BALISORE, a fea-port town of Afia, in the Eaft Indies, to the northweft of the bay of Bengal. It is about four miles from the fea by land, but 20 by the river; feated in a very fruitful foil, producing rice, wheat, aromatic feeds, tobacco, &c. The inhabitants make feveral fort of ftuffs of cotton, filk, and a kind of grafs. The Englifh, French, and Dutch, have factories here; but they are now of no great account. E. Long. 85. 20. N. Lat. 21. 30.

BALISTES, in ichthyology, a genus of fifhes belonging to the order of amphibia nantes. The characters are thefe: The head is flat; there are eight teeth in each fide, and the two anterior ones are longeft; in the place of gills, the baliftes has an aperture immediately above the pectoral fins; the body is flat, the fcales are joined together by the fkin, and the belly is keeled. The fpecies of this genus are eight, *viz.* 1. The monoceros, whofe head-fin confifts of but one ray, and the tail-rays are carinated. It is called the *unicorn-fifh* by Catefby; who informs us, that the guts of this fifh are full of fmall fhells and coralline fubftances, which by the ftrength and hardnefs of its jaws it is enabled to grind very fmall. Thefe fifh, he adds, are not eat, being accounted poifonous. They moft frequent thofe feas, amongft the Bahama iflands, where the corals are in great plenty. 2. The hifpidus, whofe head-fin is uniradiated; and there is a round black fpot in the tail-fin. The body is rough, and briftly towards the tail. The fpine or horn is fituated between the eyes; the fnout is fubulated; and inftead of a belly-fin, it has a jagged fharp fpine. This fpecies is a native of Carolina. 3. The tomentofus, whofe head fin is biradiated, and the body of it towards the hind part is hairy. It is a native of America. 4. The papillofus, has a biradiated back-fin, and a papillous body. 5. The verrucofus, has a triradiated back-fin; and the tail is full of little warts. In the place of a belly-fin, this fpecies has a large, thick, warty ray. It has 25 fmall reverfed fharp fpines at the fide of the tail, difpofed in four rows. It is a native of India. 6. The aculeatus has a triradiated back-fin; and the spines of the tail lean upon each other. It is also a native of India. 7. The vetula, or old wife, has a triradiated back-fin; the belly-fin is longitudinal, and somewhat carinated; and the tail-fin is forked. It is found at Ascension island. 8. The ringens, has a triradiated back-fin; there are three folds on each side of the head, and the tail-fin is forked. This species is likewise found at Ascension island.

BALIVO AMOVENDO, in law, was a writ for removing a bailiff from his office, for want of having sufficient land in his bailiwick to answer the king and his people, according to the statute of Westminster, 2 reg. Orig. 78.

BALK, among builders, is sometimes used for the summer-beam of a house; sometimes for the poles and rafters, which support the roofs of barns, &c.; and sometimes for the beams used in making sea-holds.

BALK, or *Balkh,* a province of Great Buckharia in Asia, about 360 miles long and 250 broad, situated to the south of the province of Samarkand, and to the east of Bukharia Proper. It is the least of the three provinces that make up what is called *Great Buckharia*; but being extremely fertile and well cultivated, the prince draws a great revenue from it. The country particularly abounds with silk, of which the inhabitants make pretty manufactures. The Uzbecks subject to the khan of Balkh are the most civilized of all the Tartars inhabiting Great Bukharia, owing probably to their commerce with the Persians: they are likewise more industrious, and more honest, than the rest; but in other respects have the same customs with the rest of the Tartars. The province is subdivided into several counties; the most remarkable of which are Khotlan or Katlan, Tokharestan, and Badagshan. Its chief cities are Balk, Fariyab, Talkhan, Badagshan, and Anderab.

BALK, the capital of the abovementioned province, situated on the frontiers of Persia, in E. Long. 65. 20. N. Lat. 37. 0. It is probably the ancient Bactra, capital of the kingdom of Bactria; and is said by the Persians to have been founded by Kay-umarraz the first king of Persia, because he met his brother upon the spot where it stood, after he had been lost for a long time; *balkhiden,* or *balghiden,* in the Persic language, signifying to receive and embrace a friend. The first kings of Persia who resided in the province of Media or *Aderbijan,* considered this city as one of their principal frontiers on the side of Scythia. In the 27th year of the Hegira, of Christ 647, Balk was reduced by the Arabs, under the command of Abdallah Ebn Amer. It continued subject to Arab princes till the year of the Hegira 432, of Christ 1041; when it was reduced by Togrol Beg, the Tangrolipix of the Greeks, and prince of the Seljukian dynasty. It was taken by Jenghiz Khan, A. D. 1221, who with his usual and unparalleled cruelty caused all the inhabitants to be brought without the walls and massacred without mercy. In 1369, Sultan Hosein, the last of the race of Jenghiz Khan was driven from Balkh by Tamerlane, whose successors were driven out by the Uzbecks in the 15th century. It was afterwards redeemed by Shah Ismael Sufi; but finally wrested out of his hands by the Uzbeck Tartars, between whom and the Persians it is the occasion of almost continual wars. It was, not long since, the residence of a khan of Tartars. It is the most considerable city possessed in these parts by the Mahometan Tartars, is large, well built and populous, the houses consisting for the most part of stone or brick. The fortifications consist of bulwarks of earth, fenced without with a strong wall high enough to cover the soldiers employed in defence of those fortifications. As this place is the resort of all the business transacted between the Indies and Great Bukharia, trade flourishes extremely at Balkh; especially as it has a fine river passing through its suburbs, which is of vast service to the town. This river falls into the Amu, in N. Lat. 38. 30. upon the confines of Great Bukharia and Kowarazm. The khan's palace, or castle, is a large edifice built after the oriental manner; and consists almost entirely of marble, of which there are fine quarries in the neighbourhood. The khan of Balk, however, was obliged in 1739 to submit to the Persians under Khouli Kan; but since that time has most probably regained his independency.

BALKERS, in the fishery, persons placed on rocks, and eminences at sea, to spy the herring droves, and give notice to the fishermen, by waving boughs, what way they go, and where they may be found.

BALL, in a general sense, a spherical and round body, whether naturally so, or formed into that figure by art.

BALL, in the military art, comprehends all sorts of bullets for fire-arms, from the cannon to the pistol. Cannon-balls are of iron; musket-balls, pistol-balls, &c. are of lead. The experiment has been tried of iron balls for pistols and fusees; but they are justly rejected, not only on account of their lightness, which prevents them from flying straight, but because they are apt to furrow the barrel of the pistol, &c.

BALL of a Pendulum, the weight at the bottom. In shorter pendulums, this is called the *bob.*

BALL, in pyrotechnics, is also a composition of various combustible ingredients, serving to burn, smoke, give light, &c. In this sense we read of fire-balls, light-balls, smoke-balls, stink-balls, sky-balls, water-balls, land-balls.

BALL, among the Cornish miners, signifies a tin-mine.

BALL, among printers, a kind of wooden tunnel stuffed with wool, contained in a leather cover, which is nailed to the wood, with which the ink is applied on the forms to be wrought off. See PRINTING.

Horse-BALLS, among farriers. Horses have a very nice taste; it is therefore proper to give the more disagreeable drugs in the form of balls, and to make drenches of the more palatable. Balls should be of an oval shape, not exceeding the size of a pullets egg; and should be dipped in sweet oil to make them slip down the easier. Some horses have a strait gullet, which makes them very averse to a ball being thrust down their throats; such horses had better have drenches given them, or their medicines may be mixed with bran, or in their mashes. See FARRIERY, *Passim.*

BALL Vein, in mineralogy, a name given by the miners of Sussex to a sort of iron ore, common there, and wrought to considerable advantage. It yields not any great quantity of metal, but what it has runs freely in the fire; it is uſually found in looſe maſſes, not in the form of a ſtratum, and is often covered with one or more cruſts. It generally contains ſome ſparkling particles; and is uſually of a circular form in the perfect maſſes, thickeſt in the middle, and gradually thinner as it approaches the ſides. The ores of Suſſex in general are poor, but they require very little trouble in the working; ſo that a conſiderable profit is made annually from them.

Ball and Socket is an inſtrument made of braſs, with a perpetual ſcrew, ſo as to move horizontally, vertically, and obliquely; and is generally uſed for the managing of ſurveying and aſtronomical inſtruments.

Puff-Ball, the Engliſh name of the lycoperdon. See Lycoperdon.

Martial Balls, in pharmacy, are a mixture of filings of iron and cream of tartar, formed into a ſolid conſiſtence and form of a ball, which is uſed to impregnate water or other liquids with iron diſſolved by the tartareous acid. To make theſe balls, one part of filings of iron and two parts powdered cream of tartar are mixed well together, and put into an earthen or iron veſſel with ſome water. The mixture is to be ſtirred from time to time till it becomes almoſt dry; and then it is to receive more water, and to be ſtirred as before. This treatment is to be continued till it acquires, when nearly dry, ſomewhat of the conſiſtence and tenacity of ſoftened roſin. Then it is to be rolled up in the form of a ball, which is generally kept tied up in a rag; and when intended to be uſed, it is to be infuſed in water, till it gives ſome colour to that liquid. The infuſion of martial balls is tonic, vulnerary, diſcutient and aperitive; and is employed both internally and externally*. Iron being ſoluble in all acids, is attacked in this preparation by the tartareous acid, which reduces it to a kind of neutral ſalt not cryſtallizable. This ſalt would remain liquid, and would form a ſoluble martial tartar, called *tartariſed tincture of Mars*. If proper proportions of filings of iron and cream of tartar be uſed, and treated long enough for an entire and complete combination, nothing would be obtained but a liquor or magma, which could not be preſerved in a ſolid form, but would be continually moiſt. Therefore, in the martial ball there is a good deal of the cream of tartar and filings of iron not combined together, by which its ſolidity is preſerved.

* See *Iron*.

Mercurial Balls, in pharmacy, are an amalgam of mercury and tin, ſufficiently ſolid to be moulded, and to preſerve a given form. The method of making them is by adding mercury to melted tin, and pouring the fluid maſs into a round hollow mould.—Theſe balls are employed to purify water, in which they are boiled; for which purpoſe travellers often carry ſome along with them. Nothing, however, can be more pernicious than ſuch a practice, ſhould the water contain any nitrous acid, which it very often does.

Balls of Silk worms and Spiders, are little caſes or cones of ſilk, wherein thoſe inſects depoſite their eggs. Spiders are extremely tender of their balls, which they carry about with them adhering to the papillæ about their anus. Grew mentions balls or bags of a ſpecies of ſilk-worms in Virginia, as big as hens eggs, and containing each four aurelias.

Zoologiſts ſpeak of a ſort of balls of hair covered over with a ſmooth ſhining coat, or ſhell found in the ſtomachs of oxen, cows, calves, horſes, ſheep, and goats. See the article Bezoar.

Balls of Fire, in meteorology. See Fire (*Balls of*).

Balls in electricity, are two pieces of cork, or pith of elder, nicely turned in a lathe to the ſize of a ſmall pea, and ſuſpended by fine linen threads; intended as electrometers, and of excellent uſe to diſcover ſmall degrees of electricity, to obſerve the changes of it from poſitive to negative, and *vice verſa*; and to eſtimate the force of a ſhock before the diſcharge, ſo that the operator ſhould always be able to tell very nearly before the diſcharge, by knowing how high he has charged his jars, what the exploſion will be.

Fire-Balls, are bags of canvas filled with gunpowder, ſulphur, ſaltpetre, pitch, &c. to be thrown by the ſoldiers, or out of mortars, in order to fire the houſes incommoding trenches, advanced poſts, or the like.—The Greeks had divers kinds of fire-balls, or Πυροβολοι λιθοι; one kind called more particularly, σκυταλια, or σκυταλιδες, made of wood, ſometimes a foot, or even a cubit long; their heads being armed with ſpikes of iron, beneath which were hemp, pitch, and other combuſtibles, which being ſet on fire, they were caſt among the enemy. The preparations of fire-balls, among the moderns, conſiſt of ſeveral operations, viz. making the bag, preparing the compoſition, tying, and, laſtly, dipping the ball. 1. The bags for this purpoſe are either oval or round. 2. The compoſition wherewith fire-balls are filled is various: To ten pounds of meal-gunpowder add two of ſaltpetre, one of ſulphur, and one of colophony; or, to ſix pounds of gunpowder, add four of ſaltpetre, four of ſulphur, one of powdered glaſs, half a pound of antimony, as much camphor, an ounce of ſal-ammoniac, and four of common ſalt, all pulveriſed. Sometimes they even fill fire-balls with hand granadoes. 3. For tying the fire-balls, they prepare two iron rings, one fitted round the aperture, where the ball is to be lighted, the other near its baſe. A cord is tied to theſe rings in ſuch a manner, as that the ſeveral turns repreſent ſemicircles of the ſphere cutting the globe through the poles: over the cords, extended according to the length of the ball, others are tied, cutting the former at right angles, and parallel to each other, making a knot at each interſection: laſtly, after putting in a leaden bullet, the reſt of the ſpace is filled with tow or paper. 4. Thus completed, the fire-ball remains to be dipped in a compoſition of melted pitch four pounds, colophony two, and linſeed oil or oil of turpentine two; after dipping, they cover it round with tow, and dip again, till it be brought to the juſt diameter required.

Light-Balls, are ſuch as diffuſe an intenſe light around; or they are balls which, being caſt out of the hand or a mortar, burn for ſome time, and illuminate the adjacent parts. 1. Luminous or light-balls for the hand, are made of ground powder, ſaltpetre, brimſtone, camphor, and borax, all ſprinkled with oil, and moulded into a maſs with ſuet; and this is wrapped up in tow, with a ſheet of ſtrong paper over it. To fire it, they make a hole into it with a bodkin, into which they put ſome priming that will burn ſlow. Its uſe is to be caſt into any works they would diſcover in the night-time. 2. For the larger light-balls, or thoſe

those to be thrown to a greater distance, they melt equal quantities of sulphur, turpentine, and pitch; and herein dip an earthen or stone-ball, of a diameter much less than that of the mortar out of which the fire-ball is to be cast; then rolling it in gun-powder, and covering it round with gauze, they dip it again, and repeat the rest till it come to fit the cavity of the mortar: lastly, they sprinkle it around with gun-powder. This, being once kindled, will strongly illuminate all around the place where it is thrown, and give opportunity to examine the state and condition thereof.

Smoke or Dark BALLS, those which fill the air with smoke, and thus darken a place to prevent discoveries. To prepare a darkening ball, make an oval or spherical bag, melt rosin over the coals, and add an equal part of saltpetre not purified, also of sulphur, and a fifth part of charcoal. The whole being well incorporated, put in tow first shred, and fill the bags with this composition, and dip it after the same manner as a fire-ball.

Stink-BALLS, those which yield a great stench where fired to annoy the enemy. Their preparation is thus: Melt ten pounds of pitch, six of rosin, twenty of saltpetre, eight of gun-powder, and four of colophony; to these add two of charcoal, six of horse-hoofs cut small, three of assafœtida, one of stinking-saracen, and any other offensive ingredients. The rest as in the former.

Sky-BALLS, those cast on high out of mortars, and which, when arrived at their height, bursting like rockets, afford a spectacle of decoration. Sky-balls are made of a wooden shell, filled with various compositions particularly that of the stars of rockets. These are sometimes intermixed with crackers and other combustibles, making rains of fire, &c.

Water-BALLS, those which swim and burn a considerable time in the water, and at length burst therein. These are made in a wooden shell, the cavity of which is filled with refined saltpetre, sulphur, saw-dust boiled in water of saltpetre, and dried; to which sometimes other ingredients are added, as iron-filings, Greek pitch, amber dust, powdered glass, and camphor. The ingredients are to be ground, mixed up, and moistened with linseed oil, nut oil, olive oil, hempseed oil, or petrol. At the bottom is placed an iron coffin, filled with whole gunpowder, that the ball may at last burst with a greater noise: and, lastly, the ball is, by the addition of lead or otherwise, made of the same specific gravity with water.

Land-BALLS are those which, being thrown out of a mortar, fall to the ground, burn, and burst there. The ingredients are much the same as in the *water-balls*, only the specific gravity is not attended to.

BALLAGHAN, a town of Ireland, in the county of Sligo, and province of Connaught. W. Long. 9. 50. N. Lat. 53. 48.

BALLAN, a town of France, in the diocese of Mons, with the title of a marquisate, seated on the river Orne. E. Long. 0. 20. N. Lat. 48. 10.

BALLAD, a kind of song, adapted to the capacity of the lower class of people; who, being mightily taken with this species of poetry, are thereby not a little influenced in the conduct of their lives. Hence we find, that seditious and designing men never fail to spread ballads among the people, with a view to gain them over to their side.

BALLAST, an heavy matter, as stone, gravel, iron, &c. thrown into the hold of a ship, in order to make her sink a proper depth in the water, that she may be capable of carrying a sufficient quantity of sail without oversetting.

There is often great difference in the proportion of ballast required to prepare ships of equal burden for a voyage; the quantity being always more or less according to the sharpness or flatness of the ship's bottom, which seamen call the *floor*.

The knowledge of ballasting a ship with propriety, is certainly an article that deserves the attention of the skilful mariner: for although it is known, that ships in general will not carry a sufficient quantity of sail till they are laden so deep that the surface of the water will nearly glance on the extreme breadth amidships, yet there is more than this general knowledge required; since, if she has a great weight of heavy ballast, as lead, iron, &c. in the bottom, it will place the centre of gravity too low in the hold; and although this will enable her to carry a great sail, she will nevertheless sail very heavily, and run the risk of being dismasted by her violent rolling.

To ballast a ship, therefore, is the art of disposing those materials so that she may be duly poised, and maintain a proper equilibrium on the water, so as neither to be too *stiff* nor too *crank*, qualities equally pernicious: as in the first, although the ship may be fitted to carry a great sail, yet her velocity will not be proportionably increased; whilst her masts are more endangered by her sudden jerks and excessive labouring: and in the last, she will be incapable of carrying sail, without the risk of oversetting.

Stiffness, in ballasting, is occasioned by disposing a great quantity of heavy ballast, as lead, iron, &c. in the bottom, which naturally places the centre of gravity very near the keel; and that being the centre, about which the vibrations are made, the lower it is placed, the more violent will be the motion of rolling.

Crankness, on the other hand, is occasioned by having too little ballast, or by disposing the ship's lading so as to raise the centre of gravity too high, which also endangers the mast in carrying sail when it blows hard: for when the masts lose their perpendicular height, they strain on the shrouds in the nature of a lever, which encreases as the sine of their obliquity; and a ship that loses her masts is in great danger of being lost.

The whole art of ballasting, therefore, consists in placing the centre of the gravity to correspond with the trim and shape of the vessel, so as neither to be too high nor too low; neither too far forward nor too far aft, and to lade the ship so deep, that the surface of the water may nearly rise to the extreme breadth amidships; and thus she will be enabled to carry a good sail, incline but little, and ply well to the windward.

Ships are said to be *in ballast* when they have no other loading. Masters of vessels are obliged to declare the quantity of ballast they bear, and to unload it at certain places. They are prohibited unloading their ballast in havens, roads, &c. the neglect of which has ruined

ruined many excellent ports.—Ships and veſſels taking in ballaſt in the river Thames, are to pay ſo much a tun to Trinity-houſe, Deptford; who ſhall employ ballaſtmen, and regulate them; and their lighters to be marked, &c. on pain of 10l.

BALLATOONS, large heavy luggage-boats uſed for carrying wood by the river from Aſtracan and the Caſpian ſea from Moſcow. Theſe will carry from 100 to 200 ton, and have from 100 to 120 men employed to row and tow them along.

BALLENDEN (Sir John), a Scottiſh poet, in the reign of James V. of Scotland, was deſcended from an ancient family in that kingdom. His father, Mr Thomas Ballenden of Auchinoul, was director to the chancery in the year 1540, and clerk-regiſter in 1541. Where our poet was educated, we are not informed; but from one of his poems we learn, that in his youth he had ſome employment at the court of king James V. and that he was in great favour with that prince. Having taken orders, and being created doctor of divinity, at the Sorbonne, he was made canon of Roſs, and archdeacon of Murray. He likewiſe obtained the place of clerk-regiſter, but was afterwards deprived of that employment by the factions of the times; however, in the ſucceeding reign, of Mary, he recovered that office, and was one of the lords of ſeſſion. Being a zealous papiſt, he, in conjunction with Dr Laing, was extremely aſſiduous in retarding the progreſs of the reformation; till at laſt, finding the oppoſition too powerful, he quitted Scotland, and went to Rome, where he died in the year 1550. He is generally eſteemed one of the beſt Scottiſh poets of that age. His works are, 1. *The hiſtory and chronicles of Scotland of Hector Boëis* (Boethius), *tranſlated by Mr John Ballenden*, Edinb. 1536. This is not a mere traſlation, Ballenden having corrected ſeveral miſtakes of his author, and made large additions. It is in folio, and black letter. 2. *Coſmography to the hiſtory of Scotland*, with a poetical proem. 3. *A deſcription of Albany*. 4. *Tranſlation of Boethius's deſcription of Scotland*. 5. *Epiſtles to king James* V. Bale ſays he had ſeen theſe letters. 6. Several poems in Carmichael's collection of Scottiſh poems; beſides many others in manuſcript, in private libraries in Scotland. 7. *Virtue and vyce*, a poem addreſſed to king James V.

BALLET, BALET, or BALETTO, a kind of dramatic poem, repreſenting ſome fabulous action or ſubject divided into ſeveral entries; wherein ſeveral perſons appear, and recite things under the name of ſome deity, or other illuſtrious character.

BALLET is more particularly uſed for a kind of comic dance, conſiſting of a ſeries of ſeveral airs of different kinds of movements, which together repreſent ſome ſubject or action. They are performed chiefly by maſks repreſenting ſylvans, tritons, nymphs, ſhepherds, and the like; and conſiſt of three parts, the entry, figure, and the retreat. The word is of Greek origin, formed from βαλλειν, *jacere*, to caſt, throw, or toſs; whence alſo in writers of the middle age, we find *ballationes* for *ſaltationes*, dancings; and *ballare* for *ſaltare*, to dance.

BALLIAGE, or BAILIAGE, in commerce, a ſmall duty paid to the city of London by aliens, and even denizens, for certain commodities exported by them.

BALLICONNEL, a town of Ireland, in the county of Cavan, and province of Ulſter. W. Long. 7. 45. N. Lat. 54. 6.

BALLISHANNON, a large town of Ireland, in the county of Donegal, or Tyrconnel, with a good haven. W. Long. 8. 25. N. Lat. 54. 25.

BALLISTA, a machine uſed by the ancients for ſhooting darts; it reſembled in ſome meaſure our croſs-bow. The word is Latin, ſignifying a croſs-bow; and is derived foom the Greek, βαλλω, to *ſhoot*, or *throw*.

Vegetius informs us, that the balliſta diſcharged darts with ſuch rapidity and violence, that nothing could reſiſt their force: and Athenæus adds, that Agiſtratus made one of little more than two feet in length, which ſhot darts 500 paces.

In Plate XCVII. is repreſented the balliſta uſed in ſieges, according to the chevalier Folard: 2, 2, the baſe of the balliſta; 3, 4, upright beams; 5, 6, tranſverſe beams; 7, 7, the two capitals in the upper tranſverſe beam, (the lower tranſverſe beam has alſo two ſimilar capitals, which cannot be ſeen in this tranſverſe figure); 9, 9, two poſts or ſupports for ſtrengthening the tranſverſe beams; 10, 10, two ſkains of cords faſtened to the capitals; 11, 11, two arms inſerted between the two ſtrands, or parts of the ſkains; 12, a cord faſtened to the two arms; 13, darts which are ſhot by the balliſta; 14, 14, curves in the upright beams, and in the concavity of which cuſhions are faſtened, in order to break the force of the arms which ſtrike againſt them with great force when the dart is diſcharged; 16, the arbor of the machine, in which a groove or canal perfectly ſtraight is formed, and in which the darts are placed in order to their being ſhot by the balliſta; 17, the nuts of the trigger; 18, the roll or windlaſs, about which the cord is wound; 19, an hook, by which the cord is drawn towards the centre, and the balliſta cocked; 20, a ſtage or table on which the arbor is in part ſuſtained.

BALLISTEUM, or BALLISTRÆA, in antiquity, a military ſong or dance uſed on occaſions of victory. Vopiſcus has preſerved the *balliſteum* ſung in honour of Aurelian, who, in the Sarmatian war, was ſaid to have killed 48 of the enemy in one day with his own hand. *Mille, mille, mille, mille, mille, mille decollavimus: Unus homo mille, mille, mille, mille decollavit; mille, mille, mille vivat, qui mille, mille occidit. Tantum vini habet nemo, quantum fudit ſanguinis.* The ſame writer ſubjoins another popular ſong of the ſame kind: *Mille Francos, mille Sarmatas, ſemel occidimus; mille, mille, mille, mille, mille Perſas quærimus.* It took the denomination *balliſteum* from the Greek βαλλω *jacio*, or *jacto*, to caſt or toſs, on account of the motions uſed in this dance, which was attended with great elevations and ſwingings of the hands. The *balliſtea* were a kind of popular ballads, compoſed by poets of the lower claſs, without much regard to the laws of metre.

BALLOON, or BALLON, in a general ſenſe, ſignifies any ſpherical hollow body, of whatever matter it be compoſed, or for whatever purpoſes it be deſigned. Thus, with chemiſts, balloon denotes a round ſhort-necked veſſel, uſed to receive what is diſtilled by means of fire; in architecture, a round globe on the top of a pillar; and among engineers, a kind of bomb made of paſteboard, and played off in fire-works, either in the air or on the water, in imitation of a real bomb.

Air-Balloon. See Aerostation and *Air-balloon.*

Balloon alfo denotes a kind of game fomething refembling tennis. The balloon is played in the open field, with a great round ball of double leather blown up with wind, and thus driven to and fro with the ftrength of a man's arm, fortified with a brace of wood.

Balloon, or Balloen, is more particularly ufed among voyagers for the ftate-barges of Siam. The balloons are a kind of brigantine, managed with oars, of very odd figures, as ferpents, fea-horfes, &c. but, by their fharpnefs and number of oars, of incredible fwiftnefs. The balloons are faid to be made of a fingle piece of timber, of uncommon length; they are raifed high, and much decorated with carving at head and ftern: fome are gilt over, and carry 120 or even 150 rowers on each fide. The oars are either plated over with filver, or gilt, or radiated with gold; and the dome or canopy in the middle, where the company is placed, is ornamented with fome rich ftuff, and furnifhed with a balluftrade of ivory, or other coftly matter, enriched with gilding. The edges of the balloon juft touch the water, but the extremities rife with a fweep to a great height. Some are adorned with variety of figures, made of pieces of mother of pearl inlaid: the richer fort, inftead of a dome, carry a kind of fteeple in the middle; fo that, confidering the flendernefs of the veffel, which is ufually 100 or 120 feet long, and fcarce fix broad, the height of the two ends, and of the fteeple, with the load of decorations, it is a kind of miracle they are not overfet.

Balloon, in the French paper-trade, is a term for a quantity of paper, containing 24 reams.

Balloon, Ballon, or Ballot, in the French glafs-trade, fignifies a certain quantity of glafs-plates, fmaller or greater according to their quality. The ballon of white glafs contains 25 bundles, of fix plates per bundle; but the ballon of coloured glafs is only of $12\frac{1}{2}$ bundles, and of three plates to a bundle.

BALLOTA, white horehound: A genus of the gymnofpermia order, belonging to the didynamia clafs of plants: and in the natural method ranking under the 42d order, *Verticillatæ.* The calyx has 5 teeth, with 10 ftriæ; and the upper lip of the corolla is crenated. It is a common weed growing on the fides of banks in moft parts of England, as alfo in walk-places near towns and villages in Scotland; fo is feldom admitted into gardens. The flowers grow in whorls, upon branched peduncles, and lean on one fide of the ftalk; they are commonly of a dull red colour, but fometimes white. It was formerly ufed in hyfteric cafes, but is now fallen into difufe. The Swedes reckon it almoft an univerfal remedy in the difeafes of their cattle. Horfes, cows, fheep, and goats, refufe to eat it.

BALLOTADE, in the menage, the leap of a horfe between two pillars, or upon a ftraight line, made with juftnefs of time, with the aid of the hand and the calves of the legs: and in fuch a manner, that when his fore-feet are in the air, he fhows nothing but the fhoes of his hinder-feet without yerking out.

BALLOTING, a method of voting at elections, &c. by means of little balls ufually of different colours, by the French called *ballots;* which are put into a box privately.

BALLS, or Ballets, in heraldry, a frequent bearing in coats of arms, ufually denominated, according to their colours, bezants, plates, hurts, &c.

BALLUSTER, a fmall kind of pillar ufed for ballustrades.

BALLUSTRADE, a feries or row of ballufters, joined by a rail; ferving as well for a reft to the elbows as for a fence or inclofure to balconies, altars, ftaircafes, &c. See Architecture, n° 74.

BALM, in botany. See Melissa.

Balm, or Balsam. See Balsam.

Balm of Gilead. See Amyris.

BALNAVES (Henry), a Scottifh proteftant divine, born in the fhire of Fife, in the reign of James V. and educated at the univerfity of St Andrew's. He went afterwards to France in order to finifh his ftudies; and returning to Scotland, was admitted into the family of the earl of Arran, who at that time governed the kingdom: but in the year 1542 the earl difmiffed him for having embraced the Proteftant religion. In 1564, he joined, fays Mackenzie, the murderers of cardinal Beaton; for which he was declared a traitor, and excommunicated. Whilft that party were befieged in the caftle of St Andrew's, they fent Balnaves to England, who returned with a confiderable fupply of provifions and money; but being at laft obliged to furrender to the French, he was fent with the reft of the garrifon to France. He returned to Scotland about the year 1559; and having joined the congregation, he was appointed one of the commiffioners to treat with the duke of Norfolk on the part of queen Elizabeth. In 1563 he was made one of the lords of feffion, and appointed by the general affembly, with other learned men, to revife the Book of Difcipline. Knox, his cotemporary, and fellow-labourer, gives him the character of a very learned and pious divine. He died at Edinburgh in the year 1579. He wrote, 1. *A Treatife concerning Juftification.* Edinb. 1550. 8vo. 2. *A Catechifm, or Confeffion of Faith.* Edinb. 1584, 8vo.

BALNEARII servi, in antiquity, fervants or attendants belonging to the baths. Some were appointed to heat them, called *fornicatores;* others were denominated *capfarii,* who kept the cloaths of thofe that went into them; others *aliptæ,* whofe care it was to pull off the hair; others *unctuarii,* who anointed and perfumed the body.

BALNEARIUS fur, in antiquity, a kind of thief who practifed ftealing the cloaths of perfons in the baths; fometimes alfo called *fur balnearum.* The crime of thofe thieves was a kind of facrilege; for the hot baths were facred: hence they were more feverely punifhed than common thieves who ftole out of private houfes. The latter were acquitted with paying double the value of the thing ftolen; whereas the former were punifhed with death.

BALNEUM, a term ufed by the chemifts to fignify a veffel filled with fome matter, as fand, water, or the like, in which another is placed that requires a more gentle heat than the naked fire. See Chemistry, n° 79.

BALSA, an ancient town of Lufitania in the Ager, Cunæus; now *Tavira,* capital of Algarva.

BALSAM, or Native Balsam, an oily, refinous, liquid fubftance, flowing either fpontaneoufly, or by means of incifion, from certain plants. There are a great variety of balfams, generally denominated from the

the substances from which they are obtained; and which are explained under their names as they occur.

BALSAMICS. *Balsamica* is a Latin word which signifies *mitigating*. The term *balsamic* is a very lax one; it includes medicines of very different qualities, as emollients, detergents, restoratives, &c. but in medicines of all these kinds there seems to be this requisite in them, *viz.* that they be soft, yielding, and adhesive, also that by their smallness they have a ready disposition to motion. Medicines of this tribe are generally required for complaints whose seat is in the viscera; and as they cannot be conveyed there but by the common road of the circulation, it follows, that no great effects can be expected from them but by their long continuation. Hoffman calls by the name of *balsamics* those medicines which are hot and acrid, also the natural balsams, gums, &c. by which the vital heat is increased.

Motherby's Med. Dict.

BALSORA. See BASSORA.

BALTAGI, among the Turks, porters, and hewers of wood, in the court of the grand signior; who also mount on horseback when the emperor rides out. Part of them also, who, for that purpose, must be castrated, keep watch at the gates of the first and second courts of the seraglio. These last are called *capigi*, and their commander *capigi pascha*.

BALTIC SEA, a great gulph surrounded by Sweden, Russia, Courland, Prussia, Pomerania, and Denmark. The king of Denmark levies a tax at Elsineur on every ship that enters the Baltic sea. It is remarkable that this sea never ebbs nor flows, and there is always a current sets through the sound into the ocean. It is generally frozen over three or four months in the year. Yellow amber is found in plenty on this coast.

BALTIMORA, in botany: a genus of the polygamia necessaria order, belonging to the syngenesia class of plants. The receptaculum is chaffy; there is no pappus; the calyx is cylindrical and polyphyllous; and the ray of the corolla is quinqueflorous. There is but one species, the recta, a native of Maryland.

BALTIMORE, a large and flourishing town of Maryland, in North America, situated on the north side of Patapsco river around the bason, in which the water rises to the depth of about six feet in common tides, but at Fell's Point the water is deep enough for ships of burden to come up. The trade and consequent improvement of Baltimore has been more rapid than that of any town in the United States: the principal trade of Maryland centers here, and its exports to Europe and the West Indies are extensive. The streets are well built and handsome: and the inhabitants are hospitable to strangers, and maintain a friendly social intercourse with one another. The town stands low and was formerly unhealthy, which the great increase of buildings and improvements, particularly the paving of the streets have contributed to remedy. Its situation is favourable for defence against a naval force, as the entrance to the harbour, about a mile below Fell's Point, is not more than a pistol shot across. W. Long. 76. 30. N. Lat. 39. 21.

BALTIMORE, a town of Ireland in the county of Corke, and province of Munster, with the title of a barony. It is seated on a headland which runs into the sea, five miles north-east of Cape Clear. W. Long. 9. 10. N. Lat. 51. 15.

BALTIMORE-*Bird*. See ORIOLUS.

BALUCLAVO, or JAMBOL, a sea-port town of Crimea on the Black Sea, where they build ships for the Grand Signior. E. Long. 35. 15. N. Lat. 44. 50.

BALUZE (Stephen), a French writer, born in 1651, and sometime librarian to M. Colbert. In 1693 he obtained a pension, with the post of director of the royal college, for writing the lives of the popes of Avignon; both which advantages he soon lost in the fluctuation of court parties. M. Baluze is much more noted for collecting ancient MSS. and illustrating them by notes, than famed for his own compositions.

BALYUR, or BALIUR, a sea-port of Africa in the kingdom of Dancali, about 14 hours journey west from Babel-Mandel. It is remarkable only for being the landing place of the Abyssinian Patriarch Alphonsus Mendez, with his Jesuits and Portuguese, on April 3d, 1724. The king, who had received orders from the Abyssinian emperor to give them a proper reception, dispatched his son to meet them and conduct them to him. The royal palace they found to consist of about half a dozen of tents, and a score of huts, fenced about with a thorn hedge, and shaded by some wild kinds of trees. Near the palace was a river, which was then quite dried up, and no water to be found but what was digged for in the channel. The hall of audience was only a large tent about a musket-shot from the rest. At the upper end was a kind of throne made of stones and clay, covered with a carpet, and two velvet cushions. At the other end was his majesty's horse with the saddle and other accoutrements hanging on one side; it being the custom of this country for the master and horse to lie together, whether king or subject. Around the hall were about 50 young men sitting cross-legged; and when the Portuguese ambassadors were admitted, they were made to sit down in the same posture. Soon after came the king preceded by some of his domestics, one having an earthen pitcher full of hydromel, another a cup made of porcelane, a third carrying a cocoa shell full of tobacco, and a fourth bringing a silver tobacco-pipe with some fire. Next to them was the king, dressed in a light silk stuff, having on his head a turban, from the rims of which hung a parcel of rings nicely wrought, which dangled before his face. He had in his hand a short kind of javelin, and was followed by all the chief officers of his court and household. The respect paid him at his coming in was by standing on their feet, and squatting down again twice, after which they went forward to kiss his hand.

BALZAC (John Lewis Guez de), born at Angouleme in 1595. Voltaire allows him the merit of having given numbers and harmony to the French prose, but censures his style as somewhat bombast. The critics of his own time gave him no little disquiet; and he gave them no little advantage over him by his sallies of vanity, and some particular propositions which were a little dangerous. Mr Balzac, getting rid of these disputes by his moderation, settled at his country seat; refined his style and genius; and got by his letters and other writings which he published from time to time, the reputation of being the first writer in France. He was at length drawn from his retirement by the hopes of making his fortune under cardinal Richleu, who

who had formerly courted his friendship; but in a few years he retired again, disgusted with the slavish dependence of a court life. All he obtained from the court was a pension of 2000 livres, with the titles of councellor of state and historiographer of France. He died in 1654; and was buried in the hospital of Notre Dame des Anges, to which he bequeathed 12,000 livres. He left an estate of 100 franks *per ann.* for a gold medal to be bestowed every two years for the best discourse on some moral subject.—Besides his letters, he wrote a work called *Oeuvres Diverses*, i. e. on various subjects; The Prince; The Christian Socrates, &c. and many other pieces; all of which have been published in two volumes folio.

BAMBA, a province of the kingdom of Congo in Africa.—It is situated between the rivers of Ambrisi and Lose; the last of which parts it from Pemba on the east, as the Ambrisi does from the province of Sogno on the north. Along the sea-coasts it extends itself northward to the river Lelunda; and on the south to that of Danda, which parts it from the kingdom of Angola. The governors of this province bear the title of *dukes*, and are always some of the princes of the royal family. They are as despotic and arbitrary as if they were really kings, notwithstanding the care and pains their monarchs have taken to keep them within due bounds. The soil of this province is very fertile; and would produce all the necessaries of life in great plenty, were the inhabitants but industrous in its cultivation. The sea-coasts produce a vast quantity of salt, which could be purified with little trouble, and would yield an extraordinary revenue if the duties were duly paid; but these the governors find means to sink mostly into their own coffers.—Here is also the fishery of the zimbis, or little sea-snail, whose shell is the current coin not only in this and the neighbouring kingdom, but also in the most distant parts of Africa. Here are also said to be mines of gold, silver, quicksilver, copper, tin, and iron; but none except the iron mines are allowed to be worked.

BAMBERG, a large handsome town of Franconia in Germany, and capital of a bishopric of the same name. It was formerly imperial, but is now subject to the bishop. The country about it produces plenty of corn, fruits, and liquorice. It has an university, founded in 1585; and is situated at the confluence of the rivers Main and Reidnitz. E. Long. 10. 15. N. Lat. 50. 10.

BAMBERG, a town of Bohemia, situated at the foot of a mountain. E. Long. 16. 50. N. Lat. 49. 53.

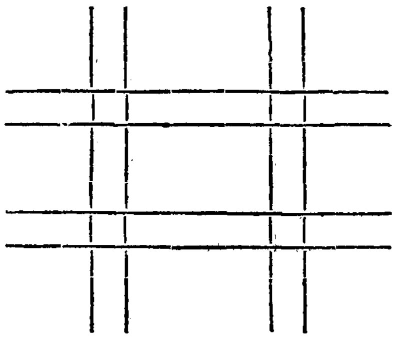
BAMBOCCIO, a celebrated painter of conversations, landscapes, cattle, &c. was born at Laeren, near Narden, in 1613. His name was Peter Van Laer; but in Italy they gave him the name of Bamboccio, on account of the uncommon shape of his body, the lower part being one third part longer than the upper, and his neck so short that it was buried between his shoulders. He had, however, an ample amends for the unseemliness of his limbs, in the superior beauties of his mind: he was endowed with an extensive genius; and, indeed, had an universal taste for every part of painting. He resided at Rome for sixteen years successively; every day studying to improve himself by those beautiful models which were continually open to his observation, and by the lovely scenery in the environs of that city. He was held in the highest esteem by all ranks of men, as well as by those of his own profession; not only on account of his extraordinary abilities, but also for the amiable qualities of his mind. He studied nature incessantly; observing with a curious exactness every effect of light on different objects, at different hours of the day; and whatsoever incident afforded pleasure to his imagination, his memory for ever perfectly retained. His stile of painting is sweet and true; and his touch delicate, with great transparency of colouring. His figures are always of a small size, well proportioned, and correctly designed; and altho' his subjects are taken but from the lower kind of nature, such as plunderings, playing at bowls, inns, farrier shops, cattle, or conversations; yet whatever he painted was so excellently designed, so happily executed, and so highly finished, that his manner was adopted by many of the Italian painters of his time. His works are still universally admired, and he is justly ranked among the first class of the eminent masters. His hand was as quick as his imagination, so that he rarely made sketches or designs for any of his works; he only marked the subject with a crayon on the canvas, and finished it without more delay. His memory was amazing: for whatever objects he saw, if he considered them with any intention to insert them in his compositions, the idea of them was so strongly impressed on his mind, that he could represent them with as much truth as if they were placed before his eyes. Sandrart observes, that although painters who are accustomed to a small size are frequently inaccurate in the disposition of the different parts of their subject, seeming content if the whole appears natural; yet Bamboccio was as minutely exact in having his figures, trees, grounds, and distances, determined with the utmost precision and perspective truth, as the best masters usually are in pictures of the largest size; which is one circumstance that causes the eye to be so agreeably deluded by the paintings of Bamboccio. In the latter part of his life, he was severely tormented with an asthmatic complaint, which he endured with much impatience; and it is reported, that as the disorder seemed to him unsupportable, he threw himself into a canal to shorten his misery, and was drowned. His death happened in 1673.

BAMBOE, in botany, the trivial name of a species of arundo. See ARUNDO.

BAMBOE-Habit; a Chinese contrivance by which a person who does not know how to swim may easily keep himself above water. The following account of it is from a letter to the author of the *Seaman's Preservative*. "In the year 1730, I was passenger in a ship from Batavia to China, burden about 400 tons, called the *Pridae*, Francisco Xavier commander, freighted by English, Chinese, and Portuguese. Near the coast of China we met one of those storms called a *Tuftoon (Tau fong)*, or a great wind, which carried away all our masts, bowsprit, and rudder; and in our hold we had six feet of water, expecting every moment the ship would founder.—We consequently were consulting our preservation: the English and Portuguese stood in their shirts only, ready to be thrown off; but the Chinese merchants came upon deck, not in a cork-jacket, but I will call it a *bamboe-habit*, which had lain ready in their chests against such dangers; and it was thus constructed; four bamboes, two before and

Bambo-rough Bambuck

and two behind their bodies, were placed horizontally, and projected about 28 inches. Theſe were croſſed on each ſide by two others, and the whole properly ſecured, leaving a ſpace for their body; ſo that they had only to put it over their heads, and tie the ſame ſecurely, which was done in two minutes, and we were ſatisfied they could not poſſibly ſink." The ſhape is here ſubjoined.



BAMBOROUGH. See *Holy-Iſland*.

BAMBUCK, a country of Africa, of which the following account is given by the Abbe Raynal, on the credit of a modern traveller whom he does not name. "In the interior part of Africa, under the 12th or 13th degree of north latitude, there is (ſays a modern traveller) a pretty large country, known by the name of *Bambuck*. It is not ſubject to a particular king; but governed by village lords, called *farims*. Theſe hereditary and independent chiefs are all obliged to unite for the defence of the ſtate, when it is either attacked as a community, or only in one of its branches.

"The territory of this ariſtocratical ſtate is dry and barren. It produces neither maize, rice, nor pulſe. The inſupportable heat it is ſubject to, proceeds in part from its being ſurrounded by high mountains, which prevent the wind from refreſhing the air. The climate is as unwholeſome as it is diſagreeable: vapours, which continually iſſue from the bowels of a ſoil replete with minerals, render this country unfit to live in, eſpecially to ſtrangers.

"It is gold that hath made this miſerable country an object worthy of notice: gold, which in the eyes of the covetous man ſeems to compenſate for all the evils of nature, tho' in reality it increaſes them all. This metal is ſo common in this country, that it is found almoſt indiſcriminately every where. To obtain it, ſometimes it is ſufficient to ſcrape the ſurface of the earth, which is clayiſh, light, and mixed with ſand. When the mine is very rich, it is digged only to the depth of a few feet, and never deeper; though it has been obſerved, that the lower it was digged, the more gold the ſoil afforded. The miners are too indolent to purſue a toil which conſtantly becomes more tedious, and too ignorant to perceive the inconveniences it would be attended with. Their negligence and their folly are in this inſtance ſo extraordinary, that in waſhing the gold, in order to ſeparate it from the earth, they only preſerve the larger pieces: the light parts paſs away with the water, which flows down an inclined plain.

"The inhabitants of Bambuck do not work theſe mines at all times, nor are they at liberty to do it when they pleaſe. They are obliged to wait till private or public wants determine the farims to grant this permiſſion. When it is proclaimed, all who are able to avail themſelves of this advantage meet at the appointed place. When their work is finiſhed, a diviſion is made. Half of the gold goes to the lord, and the remainder is equally diſtributed among the labourers. Thoſe who want gold at any other time than that of the general digging, ſearch for it in the beds of the rivers, where it is very common.

"The French and Engliſh have ſucceſſively been deſirous of appropriating to themſelves theſe real or imaginary riches. Some thought they could reach this country by the Niger, others by the Salum. Far from having ſucceeded in their attempts of becoming maſters of this country, they have not yet aſcertained its exiſtence. The unſucceſsfulneſs of paſt efforts hath redoubled the activity of ſanguine minds; ſenſible and judicious merchants have choſen to limit themſelves to a commerce much more important, which is that of ſlaves."

Bamff.

BAMFF, a ſhire of Scotland, comprehending part of Buchan, with the countries of Strathdovern, Boyn, Enzie, Strathaven, and Balvenie, extends 32 miles from eaſt to weſt, and 13 in breadth from north to ſouth. On the ſouth, it is ſeparated from part of Buchan by the river Ugie; on the eaſt it is watered by the Dovern and the German Ocean; on the weſt it is bounded by the Spey and the county of Murray; on the ſouth-weſt, it borders on Badenoch and the Braes of Mar; and on the north, it is confined by the Murray Frith. The face of the country is agreeably diverſified with hill and dale, not without woods, well watered with rivers, and exhibiting many ſeats and plantations. The air is pure and keen, the climate healthy, and the ſoil fertile, producing plentiful crops of corn. The country of Buchan, extending northwards from the river Ugie to the ſea, and weſtward as far as Devron, comprehending a tract of 20 miles in length and nine in breadth, is more free from hills and mountains than any other county of the ſame extent in the kingdom of Scotland. It is inhabited chiefly by Lowlanders, and gives the title of *earl* to the family of Erſkine; of which family, however, Erſkine of Mar is the chief. The county of Bamff abounds with the neceſſaries and comforts of life. The paſture-grounds yield ſheep, cattle, and horſes: the arable lands produce plenty of corn; while the rivers and ſea ſupply great quantities of fiſh. Various minerals have been found in different parts of the ſhire; and a piece of amber, as large as a horſe, was once caſt aſhore on the beach. In the mountainous diſtrict of Balvenie, on the weſtern ſide of the ſhire; watered by the Spey, there is a noted rock, which produces hones and whetſtones ſufficient to ſupply the whole iſland. Here are alſo veins of alum-ſtone, and ſprings of alum water. Strathallan, another diſtrict to the north-eaſt of Balvenie, abounds with ſuch plenty of lime-ſtone, that the inhabitants uſe it as common ſtone in building their houſes; and moreover burn a great quantity of it into lime, which they ſell to good advantage in the village of Keith, on the river Dovern. Along this whole coaſt, there are ancient Daniſh monuments, ſuch as cairns, tumuli, and huge ſtones ſtanding erect. In Strathaven, a hilly country, lying along the limpid

river

river Avin, which falls into the Spey, we meet with Gordon Castle, belonging to the Duke of Gordon, the most princely edifice in the north of Scotland, consisting of noble apartments magnificently furnished, and environed with fine gardens and parks well stored with fallow-deer. The same nobleman possesses several other seats in this county.

Bamff, the capital of the shire of that name in Scotland, is pleasantly situated on the side of a hill, at the mouth of the river Devron. It has several streets; of which that with the town-house in it, adorned with a new spire, is very handsome. This place was erected into a borough by virtue of a charter from Robert II. dated October 7. 1372, endowing it with the same privileges, and putting it on the same footing, with the burgh of Aberdeen; but tradition says it was founded in the reign of Malcolm Canmore. It gives title of *baron* to a branch of the Ogilvie family. The harbour is very bad, as the entrance at the mouth of the Devron is very uncertain, being often stopped by the shifting of the sands, which are continually changing in great storms; the pier is therefore placed on the outside. Much salmon is exported from hence. About Troophead some kelp is made; and the adventurers pay the lord of the manor 50 l. *per annum* for the liberty of collecting the materials. Near the town is a most magnificent seat lately built by the Earl of Fife. It lies in a beautiful plain washed by the Devron, the lofty banks of which clothed with wood on the opposite side, afford a delightful contrast to the soft vale beneath. W Long. 2. 5. N. Lat. 57. 40.

BAMIER, the name of a plant common in Egypt. It produces a pyramidal husk, with several compartments, of the colour of a lemon, and filled with musky seeds. This husk dressed with meat is a wholesome food, and has a very agreeable flavour. The Egyptians make great use of it in their ragouts.

BAMIYAN, a city of Asia, situated in the province of Zablestan, 10 days journey from Balkh, and eight from Gazna. It is remarkable only for its dreadful catastrophe when taken by Jenghiz Khan in 1221. At that time the city belonged to Sultan Jalalladin, the last of the famous Mahmud Gazni's race. Jenghiz Khan was at that time about to attack Gazna, that prince's capital; but was stopped by the garrison of Gazna, which he had hoped would give him no trouble. In this, however, he was disappointed. The people had for a long time expected an attack; and had therefore ruined the country for five or six leagues round, while the peasants had carried away the stones, and every thing that could be of use to the besiegers. Accordingly, Jenghiz Khan having erected wooden towers, and planted his engines upon them, was in a short time obliged to give over his attacks till millstones and other materials could be brought from a great distance. The walls of the city were very strong, so that the engines of the Moguls made but little impression; and the garrison making frequent and furious sallies cut off whole squadrons of their enemies, and frequently overthrew their towers and engines. This exceedingly chagrined Jenghiz Khan; who one day returning from a fruitless attack, and hearing of the defeat of one of his generals by Jalallodin, swore to be revenged on Bamiyan. This fury cost the life of one of his grandchildren; who exposing himself too much, to please his grandfather, was slain with an arrow.—At last, however, by the numberless multitude of the Moguls, who continued the attacks without intermission, the city was taken, after its walls had been ruined in many places, and the bravest soldiers and officers of the garrison slain in its defence. The mother of the young prince who had been killed entering with the troops, and more deserving the name of a fiend than a woman, caused the throats of all the inhabitants to be cut, without excepting one. She even gave orders to rip up the bellies of all the women with child, that not an infant might be left alive. In short, to gratify the rage of this inhuman monster, the buildings were all levelled with the ground; the cattle, and every living creature, destroyed; insomuch that the hardened Moguls themselves gave this place the name of *Maubalig*, which in their language signifies *the unfortunate city*. A strong castle has since been built out of its ruins.

BAMOTH-BALL (anc. geog.), one of the towns of the tribe of Reuben, which seems also to have had a temple of Baal on an eminence; lying eastwards, and not far from the river Arnon, and the territory of Moab. Jerome calls it *Bamoth*, a city of the Amorrites, beyond Jordan, in the possession of the sons of Reuben. Whether the same with that mentioned Numb. xxi. is doubtful, from the disagreement of interpreters; and yet we may admit it to be the place of encampment of the Israelites, and of Balaam's first station, or where he had the first view of the rear of the people.

BAMPTON, a town of Devonshire, situated in a bottom surrounded with high hills. W. Long. 4. 25. N. Lat. 51. 5.

BAN, or BANS. See BANN.

Ban, in commerce, a sort of smooth fine muslin, which the English import from the East Indies. The piece is almost a yard broad, and runs about 20 yards and a half.

BANANA-TREE, a species of the musa or plantain. See MUSA.

BANARES, or BENARES, a handsome town of Asia, in the dominions of the Great Mogul, greatly celebrated for its sanctity, and being the university of the Indian Bramins. See OBSERVATORY. It is seated on the north side of the river Ganges, in E. Long. 82. 30. N. Lat. 26. 20.

BANBURY, a town of Oxfordshire in England, situated on the river Charwell, in W. Long. 1. 20. N. Lat. 52. 0.

BANC, or BENCA, in law, denotes a tribunal, or judgment-seat: hence *king's banc* is the same with the *court of king's bench*, and *common banc* with that of *common pleas*.

BANCI JUS, or the privilege of having a bench, was anciently only allowed to the king's judges, *qui summam administrant justitiam*. Inferior courts, as courts-baron, hundred-courts, &c. were not allowed that prerogative: and even at this day the hundred-court at Freibridge in Norfolk is held under an oak at Gey-wood; and that of Woolfry, in Herefordshire, under an oak near Ashton in that county, called *Hundred-oak*.

BANCA, an island of Asia, in the East Indies, between Sumatra and Borneo; from the first of which it is separated only by a narrow channel. E. Long. 105. 10. N. Lat. 13. 25.

BANCALIS, a sea-port town on the east coast of the island of Sumatra, where the Dutch have a settlement. E. Long. 99. 7. N. Lat. 1. 5.

BANCK (Peter Vander), an engraver of considerable repute, was born at Paris, and received his instructions in the art from the celebrated Francois de Poilly. He came over into England with Gascar the painter about the year 1674; and married the sister of a gentleman of estate in Hertfordshire, named Forester. He was a laborious artist: but the pay he received for his plates being by no means adequate to the time he bestowed upon them, he was reduced to want; and, retiring from business, sought an asylum in the house of his brother-in-law. He died in Bradfield, and was buried in the church there, in 1674; leaving his widow in possession of the chief part of his plates, which she disposed of to Brown, a printseller, to great advantage, and left an easy fortune.—His chief employment was engraving of portraits; and, according to Virtue's account of this artist published by the Hon. Mr Walpole, he was the first in England who engraved them on so large a scale. But even the novelty, it seems, added to their merit, could not sufficiently recommend them to support the artist. Like many of Poilly's disciples, his great merit, according to Mr. Strutt, consists in the laboured neatness and management of the mechanical part of the art. Freedom, harmony, and chasteness of outline, are by no means the characteristic of his prints. However, tho' they cannot rank with the superior productions of Edelink or Nanteuil, &c. they have their share of merit; and doubtless will be always esteemed in England as preserving the best resemblance of many eminent persons who were living at that time.

BANCO, an Italian word which signifies *bank*. It is commonly used to signify the Bank of Venice.

BANCOCK, a town of the kingdom of Siam in Asia, with a fort, which was once in the possession of the French, but they were driven from it in 1688. E. Long. 101. 5. N. Lat. 13. 25.

BAND, in a general sense, some small narrow ligament, wherewith any thing is bound, tied, or fastened.

BAND, in architecture, a general name for any flat low member, or moulding, that is broad but not very deep.

BAND of Soldiers, in military affairs, those who fight under the same flag or ensign.

BAND of Pensioners, a company of 120 gentlemen, who receive a yearly allowance of 100l. for attending on his majesty on solemn occasions.

BAND is also the denomination of a military order in Spain, instituted by Alphonsus XI. king of Castile, for the younger sons of the nobility; who, before their admission, must serve 10 years at least, either in the army or at court; and are bound to take up arms for the catholic faith against the infidels.

BAND, in surgery. See BANDAGE.

BANDA ISLANDS, the general name of five islands in the East-Indies, belonging to the Dutch. Two of them are uncultivated, and almost entirely uninhabited; the other three claim the distinction of being the only islands in the world that produce the nutmeg.

If we except this valuable spice, the islands of Banda, like all the Moluccas, are barren to a dreadful degree. What they produce in superfluities they want in necessaries. The land will not bring forth any kind of corn; and the pith of the sago serves the natives of the country instead of bread.

As this food is not sufficient for the Europeans who settle in the Moluccas, they are allowed to fetch provisions from Java, Massacar, or the extremely fertile island of Bali. The company itself carries some merchandise to Banda.

This is the only settlement in the East-Indies that can be considered as an European colony; because it is the only one where the Europeans are proprietors of lands. The company finding that the inhabitants of Banda were savage, cruel, and treacherous, because they were impatient under their yoke, resolved to exterminate them. Their possessions were divided among the white people, who got slaves from some of the neighbouring islands to cultivate the lands. These white people are for the most part Creoles, or malecontents who have quitted the service of the company. In the small island of Rosinging, there are likewise several banditti, whom the laws have branded with disgrace; and young men of abandoned principles, whose families wanted to get rid of them: so that Banda is called the *island of correction*. The climate is so unhealty, that these unhappy men live but a short time. It is on account of the loss of so great a number of hands, that attempts have been made to transfer the culture of the nutmeg to Amboyna; and the company were likewise probably influenced by two other strong motives of interest, as their trade could be carried on with less expence and greater safety. But the experiments that have been made have proved unsuccessful, and matters remain in their former state.

BANDAGE, in surgery, a fillet, roller, or swath, used in dressing and binding up wounds, restraining dangerous hemorrhagies, and in joining fractured and dislocated bones.

BANDALEER, or BANDELEER, in military affairs, a large leathern belt, thrown over the right shoulder, and hanging under the left arm; worn by the ancient musqueteers, both for the sustaining of their fire-arms, and for the carriage of their musket-charges, which being put up in little wooden cases, coated with leather, were hung, to the number of twelve, to each bandaleer.

BANDELET, or BANDLET, in architecture, any little band, or flat moulding, as that which crowns the Doric architrave.

BANDER-CONGO, a small sea-port town in Asia, seated on the Persian Gulph. E. Long. 54. 10. N. Lat. 19. 0.

BANDERET, a general, or one of the commanders in chief of the forces.—This appellation is given to the principal commanders of the troops of the canton of Bern in Switzerland, where there are four banderets, who command all the forces of that canton.

BANDEROLL, a little flag, in form of a guidon, extended more in length than in breadth, used to be hung out on the masts of vessels, &c.

BANDITTI, from the Italian *bandito*; persons proscribed, or, as we call it, outlawed: sometimes denominated *banniti* or *forris banniti*. It is also a denomination given to highwaymen or robbers who infest the roads in troops, especially in Italy, France, and

and Sicily. Mr Brydone, in his Tour through Sicily, informs us, that in the eastern part, called *Val Demoni* from the devils that are supposed to inhabit Mount Ætna, it has ever been found altogether impracticable to extirpate the banditti; there being numberless caverns and subterraneous passages round that mountain, where no troops could possibly pursue them; besides, they are known to be perfectly determined and resolute, never failing to take a dreadful revenge on all who have offended them. Hence the prince of Villa Franca has embraced it, not only as the safest, but likewise as the wisest and most political scheme, to become their declared patron and protector: and such of them as think proper to leave their mountains and forests, though perhaps only for a time, are sure to meet with good encouragement and a certain protection in his service, where they enjoy the most unbounded confidence, which, in no instance, they have ever yet been found to make an improper or a dishonest use of. They are clothed in the prince's livery, yellow and green, with silver lace; and wear likewise a badge of their honourable order, which intitles them to universal fear and respect from the people.

In some circumstances, these banditti are the most respectable people of the island, and have by much the highest and most romantic notions of what they call their point of honour. However criminal they may be with regard to society in general; yet, with respect to one another, and to every person to whom they have once professed it, they have ever maintained the most unshaken fidelity. The magistrates have often been obliged to protect them, and pay them in court, as they are known to be perfectly determined and desperate, and so extremely vindictive that they will certainly put any person to death that has ever given them just cause of provocation. On the other hand, it never was known that any person who had put himself under their protection, and showed that he had confidence in them, had cause to repent of it, or was injured by any of them in the most minute trifle; but, on the contrary, they will protect him from impositions of every kind, and scorn to go halves with the landlord, like most other conductors and travelling servants, and will defend him with their lives if there is occasion. Those of their number who have thus enlisted themselves in the service of society, are known and respected by the other banditti all over the island; and the persons of those they accompany are ever held sacred. For these reasons, most travellers choose to hire a couple of them from town to town; and may thus travel over the whole island in safety.

BANDORA, the capital of the island of Salset, on the west coast of the peninsula on this side the Ganges. It is separated from the island of Bombay by a narrow channel, and subject to the Portuguese. E. Lon. 72. 30. N. Lat. 19. 0.

BANDORE, the name of a musical instrument with strings, resembling a lute, and said to be invented in the fourth year of Queen Elizabeth, by John Rose, a citizen of London.

BANDY-LEGS, from the French *bander*, 'to bend,' a distortion of the legs, when they turn either inward or outward on either side; arising from some defect in the birth or imprudence in the nurse, endeavouring to make a child stand or walk before his legs were strong enough to sustain the weight of his body. See VALGUS.

BANE (from the Sax. *bana*, a murderer), signifies destruction or overthrow. Thus, "I will be the *bane* of such a man," is a common saying. So, when a person receives a mortal injury by any thing, we say, "it was his *bane*:" and he who is the cause of another man's death, is said to be *le bane*, i. e. a malefactor.

BANFF. See BAMFF.

BANGHIR, a town of Ireland, in king's county in the province of Leinster, seated on the river Shannon. W. Long. 8. 5. N. Lat. 53. 10.

BANGLE EARS, an imperfection in a horse, remedied in the following manner. Place his ears in such a manner as you would have them stand; bind them with two little boards so fast that they cannot stir, and then clip away all the empty wrinkled skin close by the head.

BANGIUS (Thomas), a Danish divine, and an elegant Latin writer on the origin of languages and a variety of other subjects. He died in 1661.

BANGOR, an episcopal city of Carnarvonshire in North Wales. In ancient times it was so considerable, that it was called *Bangor the Great*, and defended by a strong castle: but it is now a very mean place; the principal buildings being the cathedral, the bishop's palace, and a free school. The see is of very great antiquity, and its founder unknown. The church is dedicated to St. Daniel, who was bishop here about the year 516; but for near 500 years afterwards, there is no certainty of the names of his successors. Owen Glendower greatly defaced the cathedral church; but Bishop Dean repaired it again. This see met a still more cruel ravager than Owen Glendower, in the person of Bishop Bulkeley; who not only alienated many of the lands belonging to it, but even sold the bells of the church. This diocese contains the whole of Carnarvonshire except three parishes, the shire of Anglesey, and part of the shires of Denbigh, Merioneth, and Montgomery, in which are 107 parishes, whereof 36 impropriated. It has three archdeaconries, viz. Bangor, Anglesey, and Merioneth; of which the two first are commonly annexed to the bishopric for its better support. This see is valued in the king's books at L. 131 : 16 : 4, and is computed to be worth annually L. 1200. The tenths of the clergy are L. 151 : 14 : 3½. To the cathedral there belong a bishop, a dean, an archdeacon, a treasurer, and two prebendaries, endowed; a precentor, a chancellor, and three canons, not endowed; three vicars coral, an organist, lay-clerks, choristers, and two officers. W. Long. 4. 10. N. Lat. 53. 20.

BANGOR, a town of Ireland, in the county of Down and province of Ulster. It is seated on the south shore of the bay of Carrick Fergus, opposite to the town of that name; and sends two members to parliament. W. Long. 6. N. Lat. 54. 42.

BANGUE, a species of opiate, in great use throughout the east, for drowning cares and inspiring joy.—This by the Persians is called *beng*; by the Arabs, *essrar*; corruptly *asseral*, and *assarth*; by the Turks, *bengitie*, and vulgarly called *mastack*; by the European naturalists, *bangue* or *bange*.—It is the leaf of a kind of wild hemp, growing in the countries of the Levant:

Bangue || Banians.

Levant; it differs little, either as to leaf or seed, from our hemp, except in size. Some have mistaken it for a species of althæa.

There are divers manners of preparing it, in different countries. Olearius describes the method used in Persia. Mr Sale tells us, that, among the Arabs, the leaf is made into pills, or conserves. But the most distinct account is that given by Alexander Maurocordato counsellor and physician of the Ottoman Porte, in a letter to Wedelius. According to this author, bangue is made of the leaves of wild hemp, dried in the shade, then ground to powder; and put into a pot wherein butter has been kept; set in an oven till it begin to torrify; then taken out, and pulverized again; thus to be used occasionally, as much at a time as will lie on the point of a knife. Such is the Turkish bangue.—The effects of this drug are, To confound the understanding; set the imagination loose; induce a kind of folly, and forgetfulness, wherein all cares are left, and joy and gaiety take take place thereof. Bangue in reality, is a succedaneum to wine, and obtains in those countries where Mahometanism is established; which prohibiting the use of that liquor absolutely, the poor musselmans are forced to have recourse to succedanea, to rouse their spirits. The principal are *opium* and this bangue. As to the opinion among Europeans, that the Turks prepare themselves for battle by a dose of bangue, which rouses their courage, and drives them, with eagerness, to certain death; Dr Maurocordato assures us, that it is a popular error: the Turks think they are then going assuredly to receive the crown of martyrdom; and would not, for any consideration, lose the merit of it, which they would do, by eating the bangue, as being held unlawful by their apostle, among other things which intoxicate.

BANIALUCH, or BAGNALUCH, a city of European Turkey, the capital of Bosnia, upon the frontiers of Dalmatia, near the river Setina. E. Long. 18. 20. N. Lat. 44. 20.

BANIANS, a religious sect in the empire of the Mogul, who believe a metempsychosis; and will therefore eat no living creature, nor kill even noxious animals, but endeavour to release them when in the hands of others. The name of *Banian* is used with some diversity, which has occasioned much confusion, and many mistakes. Sometimes it is taken in a less proper sense, and extended to all the idolaters of India, as contradistinguished from the Mahometans: in which sense, Banians include the Bramins and other casts. *Banians*, in a more proper sense, is restrained to a peculiar cast, or tribe, of Indians, whose office or profession is trade and merchandize; in which sense, *Banians* stand contradistinguished from *Bramins*, *Cuttery*, and *Wyse*, the three other casts, into which the Indians are divided. The four casts are absolutely separate as to occupation, relation, marriage, &c. though all of the same religion; which is more properly denominated the religion of the Bramins, who make the ecclesiastical tribe, than of the *Banians*, who make the mercantile. The proper *Banians* are called, in the *shaster*, or book of their law, by the name of *Shuddery*; under which are comprehended all who live after the manner of merchants, or that deal and transact for others, as brokers; exclusive of the mechanics, or artificers, who make another cast, called *Wyse*. These *Banians* have no peculiar sect or religion, unless it be, that two of the eight general precepts given by their legislator Bremaw to the Indian nation, are, on account of the profession of the *Banians*, supposed more immediately to relate to them, viz. those which enjoin veracity in their words and dealings, and avoiding all practices of circumvention in buying and selling.—Some of the *Banians*, quitting their possession, and retiring from the world commence religious, assume a peculiar habit, and devote themselves, more immediately to God, under the denomination of *Vertea*. These, though they do not hereby change their cast, are commonly reckoned as bramins of a more devout kind; much as monks in the Romish church, though frequently not in orders, are reputed as a more sacred order than the regular clergy. The name *Banian* imports as much, in the Bramin language (wherein their law is written), as a people innocent and harmless; void of all guile; so gentle, that they cannot endure to see either a fly or a worm injured; and who, when struck, will patiently bear it, without resisting or returning the blow.—Their mein and appearance is described by Lord *, in terms a little precise, but very significant: "A people presented themselves to my eyes clothed in linen garments, somewhat low descending, of a gesture and garb, as I may say, maidenly, and well nigh effeminate, of a countenance shy and somewhat estranged."—Gemelli Careri divides the Banians into 22 tribes, all distinct, and not allowed to marry with each other. Lord assures us they are divided into 82 casts or tribes, correspondent to the casts or divisions of the Banians or priests, under whose discipline they are, as to religious matters; tho' the generality of the Banians choose to be under the direction of the two Bramin tribes, the Visalnagranaugers and the Vulnagranaugers.

* *Discov. Relig. Banian.*

The Banians are the great factors, by whom most of the trade of India is managed; in this respect, comparable to the Jews and Armenians, and not behind either, in point of skill and experience, in whatever relates to commerce. Nothing is bought but by their mediation. They seem to claim a kind of *jus divinum* to the administration of the traffic of the nation, grounded on their sacred books, as the Bramins do to that of religion. They are dispersed, for this purpose, through all parts of Asia, and abound in Persia, particularly at Ispahan and Gombroon, where many of them are extremely rich, yet not above acting as brokers, where a penny is to be got. The chief agents of the English, Dutch, and French East India companies are of this nation: they are faithful, and are generally trusted with the cash of those companies in their keeping. They act also as bankers, and can give bills of exchange for most cities in the East Indies. Their form of contract in buying and selling is remarkable, being done without words, in the profoundest silence, only by touching each other's fingers: the buyer loosening his pamerin or girdle, spreads it on his knee, and both he and the seller having their hands underneath by the intercourse of the fingers, mark the price of pounds, shillings, &c. demanded, offered, and at length agreed on. When the seller takes the buyer's whole hand, it denotes a thousand; and as many times as he squeezes it, as many thousand pagods, or roupees, according to the species in question are, demanded: when he only takes the five fingers,

fingers, it denotes five hundred, and when only one, one hundred: taking only half a finger, to the ſecond joint, denotes fifty; the ſmall end of the finger, to the firſt joint, ſtands for ten.

BANIER (Anthony), licentiate in laws, member of the academy of inſcriptions and belles lettres, and eccleſiaſtic of the dioceſe of Clermont in Auvergne; died in November 1741, aged 69. He is principally celebrated for his tranſlation of the Metamorphoſes of Ovid, with hiſtorical remarks and explanations; which was publiſhed in 1732, at Amſterdam, in folio, finely ornamented with copperplates, by Picart; and reprinted at Paris, 1738, in two vols. 4to: and for his Mythology, or fables of the ancients explained by hiſtory; a work full of the moſt important information, which was tranſlated into Engliſh, and printed at London in 1741, in 4 vols. 8vo.

BANISHMENT, exile, among us is of two kinds: the one voluntary, and upon oath; the other by compulſion, for ſome offence or crime. The former properly called *abjuration*, is now ceaſed; the latter is chiefly enjoined by judgment of Parliament. Yet outlawing and tranſportation may alſo be conſidered as ſpecies of exile.

BANISTER (John), a phyſician and ſurgeon in the reign of queen Elizabeth, was educated at Oxford where, ſays Anthony Wood, he ſtudied logicals for a time; but afterwards applied himſelf ſolely to phyſic and ſurgery. In 1573 he took the degree of bachelor of phyſic; and obtaining a licence from the univerſity to practiſe, ſettled at Notingham, where he lived many years in great repute, and wrote ſeveral medical treatiſes. His works were collected and publiſhed in 1633, 4to.

BANISTERIA, in botany; a genus of the trigynia order, belonging to the decandria claſs of plants; and in the natural method ranking under the 23d order, *Trihilatæ*. The calyx is quinquepartite, with nectarious pores on the outſide of the baſe; the petals are roundiſh and ungulated; the ſeeds are three, with membranaceous wings. There are ſeven ſpecies, all natives of warm countries, but poſſeſſing no remarkable properties.

BANK, in commerce, a common repoſitory, where many perſons agree to keep their money, to be always ready at their call or direction: or, Certain ſocieties or communities, who take the charge of other people's money, either to improve it, or to keep it ſecure.

The firſt inſtitution of banks was in Italy, where the Lombard Jews kept benches in the market-places, for the exchange of money and bills; and *banco* being the Italian name for *bench*, banks took their title from this word.

I. Company-banks.

Banks are of two principal kinds. 1. One ſort is either *public*, conſiſting of a company of monied men, who being duly eſtabliſhed and incorporated by the laws of their country, agree to depoſite a conſiderable fund, or joint ſtock, to be employed for the uſe of the ſociety, as lending money upon good ſecurity, buying and ſelling bullion, diſcounting bills of exchange, &c.: or *private*, i. e. ſet up by private perſons, or partnerſhips, who deal in the ſame way as the former upon their own ſingle ſtock and credit.

The greateſt bank of circulation in Europe, is the *Bank of England*. The company was incorporated parliament in the fifth and ſixth years of king William and queen Mary, by the name of *The Governors and Company of the Bank of England;* in conſideration of the loan of 1,200,000l. granted to the government; for which the ſubſcribers received almoſt 8 *per cent.* By this charter, the company are not to borrow under their common ſeal, unleſs by act of parliament; they are not to trade, or ſuffer any perſon in truſt for them to trade in any goods or merchandize; but they may deal in bills of exchange, in buying or ſelling bullion, and foreign gold and ſilver coin, &c.

Bank of England; its eſtabliſhment, regulations, importance, &c.

By an act of parliament paſſed in the 8th and 9th year of William III. they were empowered to enlarge their capital ſtock to 2,201,171l. 10s. It was then alſo enacted, that bank-ſtock ſhould be a perſonal, and not a real eſtate; that no contract either in word or writing, for buying or ſelling bank-ſtock, ſhould be good in law, unleſs regiſtered in the books of the bank within 7 days, and the ſtock transferred in 14 days; and that it ſhall be felony, without benefit of clergy, to counterfeit the common ſeal of the bank, or any ſealed bank-bill, or any bank-note, or to alter or eraſe ſuch bills or notes. By another act paſſed in the 7th of queen Anne, the company were empowered to augment their capital to 4,402,343l. and they then advanced 400,000l. more to the government; and in 1714, they advanced another loan of 1,500,000l.

In the third year of the reign of king George I. the intereſt in their capital ſtock was reduced to 5 *per cent.* when the bank agreed to deliver up as many exchequer bills as amounted to 2,000,000l. and to accept an annuity of 100,000l. and it was declared lawful for the bank to call from their members, in proportion to their intereſts in the capital ſtock, ſuch ſums of money as in a general court ſhould be found neceſſary. If any member ſhould neglect to pay his ſhare of the moneys ſo called for, at the time appointed by notice in the London Gazette, and fixed upon the Royal Exchange, it ſhould be lawful for the bank, not only to ſtop the dividend of ſuch member, and to apply it towards payment of the money in queſtion, but alſo to ſtop the transfers of the ſhare of ſuch defaulter, and to charge him with an intereſt of 5 *per cent. per annum*, for the money ſo omitted to be paid: and if the principal and intereſt ſhould be three months unpaid, the bank ſhould then have power to ſell ſo much of the ſtock belonging to the defaulter as would ſatisfy the ſame. After this, the bank reduced the intereſt of the 2,000,000l. lent to the government, from 5 to 4 *per cent.* and purchaſed ſeveral other annuities, which were afterwards redeemed by the government, and the national debt due to the bank reduced to L.1,600,000. But in 1742, the company engaged to ſupply the government with 1,600,000l. at 3 *per cent.* which is now called the 3 *per cent. annuities;* ſo that the government was now indebted to the company L.3,200,000, the one half carrying 4, and the other 3 *per cent.*

In the year 1746, the company agreed that the ſum of L.986,800 due to them in the exchequer bills unſatisfied, on the duties for licences to ſell ſpirituous liquors by retail, ſhould be cancelled, and in lieu thereof to accept of an annuity of L.39,442, the intereſt of that ſum at 4 *per cent.* The company alſo agreed to advance the further ſum of L.1,000,000 into the exchequer, upon the credit of the duties ariſing by the malt

Bank.

and land tax at 4 *per cent.* for exchequer bills to be issued for that purpose; in consideration of which, the company were enabled to augment their capital with L.986,800; the interest of which, as well as that of the other annuities, were reduced to 3½ *per cent.* till the 25th of December 1757, and from that time to carry only 3 *per cent.*

And in order to enable them to circulate the said exchequer bills, they established what is now called *bank circulation*. The nature of which may be understood from what follows.

The company of the bank are obliged to keep cash sufficient not only to answer the common, but also any extraordinary demand that may be made upon them; and whatever money they have by them, over and above the sum supposed necessary for the purposes, they employ in what may be called the *trade of the company;* that is to say, in discounting bills of exchange, in buying of gold and silver, and in government securities, &c. But when the bank entered into the abovementioned contract, as they did not keep unemployed a larger sum of money than what they deemed necessary to answer their ordinary and extraordinary demands, they could not conveniently take out of their current cash so large a sum as a million, with which they were obliged to furnish the government, without either lessening that sum they employed in discounting, buying gold and silver, &c. (which would have been very disadvantageous to them), or inventing some method that should answer all the purposes of keeping the million in cash. The method which they chose, and which fully answers their end, was as follows:

They opened a subscription, which they renew annually, for a million of money; wherein the subscribers advance 10 *per cent.* and enter into a contract to pay the remainder, or any part thereof, whenever the bank shall call upon them, under penalty of forfeiting the 10 *per cent.* so advanced; in consideration of which, the bank pays the subscribers 4 *per cent.* interest for the money paid in, and ¼ *per cent.* for the whole sum they agree to furnish; and in case a call shall be made upon them for the whole, or any part thereof, the bank further agrees to pay them at the rate of 5 *per cent. per annum* for such sum till they repay it, which they are under an obligation to do at the end of the year. By this means the bank obtains all the purposes of keeping a million of money by them; and though the subscribers, if no call is made upon them (which is in general the case), receive 6¼ *per cent.* for the money they advance, yet the company gains the sum of L.23,500 *per annum* by the contract; as will appear by the following account:

	£.
The bank receives from the government for the advance of a million - -	30,000
The bank pays the subscribers who advance L.100,000 and engage to pay (when called for) L.900,000 more - -	6,500
The clear gain to the bank therefore is	23,500

This is the state of the case, provided the company should make no call on the subscribers; which they will be very unwilling to do, because it would not only lessen their profit, but affect the public credit in general.

Bank-stock may not improperly be called a *trading stock*, since with this they deal very largely in foreign gold and silver, in discounting bills of exchange, &c. Besides which, they are allowed by the government very considerable sums annually for the management of the annuities paid at their office. All which advantages render a share in their stock very valuable; though it is not equal in value to the East India stock. The company make dividends of the profits half-yearly, of which notice is publicly given; when those who have occasion for their money may readily receive it; but private persons, if they judge convenient, are permitted to continue their funds, and to have their interest added to the principal.

This company is under the direction of a governor, deputy-governor, and 24 directors, who are annually elected by the general court, in the same manner as in the East India company. Thirteen, or more, compose a court of directors for managing the affairs of the company. The officers of this company are very numerous.

The stability of the bank of England is equal to that of the British government. All that it has advanced to the public must be lost before its creditors can sustain any loss. No other banking company in England can be established by act of parliament, or can consist of more than six members. It acts, not only as an ordinary bank, but (as we have already seen) as a great engine of state; receiving and paying the greater part of the annuities which are due to the creditors of the public; circulating exchequer bills; and advancing to government the annual amount of the land and malt taxes, which are frequently not paid up till some years thereafter. It likewise has, upon several different occasions, supported the credit of the principal houses, not only of England, but of Hamburgh and Holland. Upon one occasion it is said to have advanced for this purpose, in one week, about L. 1,600,000, a great part of it in bullion.

Scotch banks, public and private.

In Scotland there are two public banks, both at Edinburgh. The one, called *The Bank of Scotland*, was established by act of parliament in 1695; the other, called *The Royal Bank*, by royal charter in 1727.

Within these 30 years there have also been erected private banking companies in almost every considerable town, and even in some villages. Hence the business of the country is almost entirely carried on by paper-currency, *i. e.* by the notes of those different banking companies; with which purchases and payments of all kinds are commonly made. Silver very seldom appears, except in the change of a twenty-shilling bank-note, and gold still seldomer. But though the conduct of all those different companies has not been unexceptionable, and has accordingly required an act of parliament to regulate it; the country, notwithstanding, has evidently derived great benefit from their trade. It has been asserted, that the trade of the city of Glasgow doubled in about 15 years after the first erection of the banks there; and that the trade of Scotland has more than quadrupled since the first erection of the two public banks at Edinburgh. Whether the trade, either of Scotland in general, or of the city of Glasgow in particular, has really increased in so great a proportion, during so short a period, we do not pretend to know. If either of them has increased in this proportion, it seems to be an effect too great to be accounted for by the

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the sole operation of this cause. That the trade and industry of Scotland, however, have increased very considerably during this period, and that the banks have contributed a good deal to this increase, cannot be doubted.

Smith's Wealth of Nations, Book II. chap. ii.

The value of the silver money which circulated in Scotland before the Union in 1707, and which immediately after it was brought into the bank of Scotland in order to be recoined, amounted to L.411,117 : 10 :9 Sterling. No account has been got of the gold coin; but it appears from the ancient accounts of the mint of Scotland, that the value of the gold annually coined somewhat exceeded that of the silver. There were a good many people too upon this occasion, who, from a diffidence of repayment, did not bring their silver into the bank of Scotland; and there was, besides, some English coin, which was not called in. The whole value of the gold and silver, therefore, which circulated in Scotland before the Union, cannot be estimated at less than a million Sterling. It seems to have constituted almost the whole circulation of that country; for though the circulation of the bank of Scotland, which had then no rival, was considerable, it seems to have made but a very small part of the whole. In the present times the whole circulation of Scotland cannot be estimated at less than two millions, of which that part which consists in gold and silver most probably does not amount to half a million. But though the circulating gold and silver of Scotland have suffered so great a diminution during this period, its real riches and prosperity do not appear to have suffered any. Its agriculture, manufactures, and trade, on the contrary, the annual produce of its land and labour, have evidently been augmented.

Discounting of bills.

It is chiefly by discounting bills of exchange, that is, by advancing money upon them before they are due, that the greater part of banks and bankers issue their promissory notes. They deduct always, upon whatever sum they advance, the legal interest till the bill shall become due. The payment of the bill, when it becomes due, replaces to the bank the value of what had been advanced, together with a clear profit of the interest. The banker, who advances to the merchant whose bill he discounts, not gold and silver, but his own promissory notes, has the advantage of being able to discount to a greater amount, by the whole value of his promissory notes, which he finds by experience are commonly in circulation. He is thereby enabled to make his clear gain of interest on so much a larger sum.

The commerce of Scotland, which at present is not very great, was still more inconsiderable when the two first banking companies were established; and those companies would have had but little trade, had they confined their business to the discounting of bills of exchange. They invented, therefore, another method of issuing their promissory notes, by granting what they called *cash accounts*; that is, by giving credit to the extent of a certain sum (L. 2000 or L. 3000 for example), to any individual who could procure two persons of undoubted credit and good landed estate to become surety for him, that whatever money should be advanced to him within the sum for which the credit had been given should be repaid upon demand, together with the legal interest. Credits of this kind are

Cash-accounts.

commonly granted by banks and bankers in all different parts of the world. But the easy terms on which the Scots banking companies accept of repayment are peculiar to them, and have perhaps been the principal cause, both of the great trade of those companies and of the benefit which the country has received from it.

Advantages from these;

Whoever has a credit of this kind with one of those companies, and borrows L. 1000 upon it for example, may repay this sum piece-meal, by L. 20 and L. 30 at a time, the company discounting a proportionable part of the interest of the great sum from the day on which each of those small sums is paid in, till the whole be in this manner repaid. All merchants therefore, and almost all men of business, find it convenient to keep such cash-accounts with them; and are thereby interested to promote the trade of those companies, by readily receiving their notes in all payments, and by encouraging all those with whom they have any influence to do the same. The banks, when their customers apply to them for money, generally advance it to them in their own promissory notes. These the merchants pay away to the manufacturers for goods, the manufacturers to the farmers for materials and provisions, the farmers to their landlords for rent, the landlords repay them to the merchants for the conveniences and luxuries with which they supply them, and the merchants again return them to the banks in order to balance their cash accounts, or to replace what they may have borrowed of them; and thus almost the whole money-business of the country is transacted by means of them. Hence the great trade of those companies.

to the banks, and

By means of those cash accounts, every merchant can, without imprudence, carry on a greater trade than he otherwise could do. If there are two merchants, one in London and the other in Edinburgh, who employ equal stocks in the same branch of trade, the Edinburgh merchant can, without imprudence, carry on a greater trade, and give employment to a greater number of people, than the London merchant. The London merchant must always keep by him a considerable sum of money, either in his own coffers, or in those of his banker (who gives him no interest for it), in order to answer the demands continually coming upon him for payment of the goods which he purchases upon credit. Let the ordinary amount of this sum be supposed L. 500. The value of the goods in his warehouse must always be less by L. 500 than it would have been, had he not been obliged to keep such a sum unemployed. Let us suppose that he generally disposes of his whole stock upon hand, or of goods to the value of his whole stock upon hand, once in the year. By being obliged to keep such a great sum unemployed, he must sell in a year L. 500 worth less goods than he might otherwise have done. His annual profits must be less by all that he could have made by the sale of L. 500 worth more goods; and the number of people employed in preparing his goods for the market, must be less by all those that L. 500 more stock could have employed. The merchant in Edinburgh, on the other hand, keeps no money unemployed for answering such occasional demands. When they actually come upon him, he satisfies them from his cash-account with the bank, and gradually replaces the sum borrowed with the money or paper which comes in from the occasional

to the country.

Bank.

casional sale of his goods. With the same stock, therefore, he can, without imprudence, have at all times in his warehouse a larger quantity of goods than the London merchant; and can thereby both make a greater profit himself, and give constant employment to a greater number of industrious people who prepare those goods for the market. Hence the great benefit which the country has derived from this trade.

The late multiplication, of banking companies in both parts of the united kingdom, an event by which many people have been much alarmed, instead of diminishing increases the security of the public. It obliges all of them to be more circumspect in their conduct, and by not extending their currency beyond its due proportion to their cash, to guard themselves against those malicious runs which the rivalship of so many competitors is always ready to bring upon them. It restrains the circulation of each particular company within a narrower circle, and reduces their circulating notes to a smaller number. By dividing the whole circulation into a greater number of parts, the failure of any one company, an accident which, in the course of things, must sometimes happen, becomes of less consequence to the public. This free competition too obliges all bankers to be more liberal in their dealings with their customers, lest their rivals should carry them away. In general, if any branch of trade, or any division of labour, be advantageous to the public, the freer and more general the competition, it will always be the more so. See further, the article *Paper-Money*.

II. Banks of deposit.

2. The other kind of banks consists of such as are instituted wholly on the public account, and are called *Banks of Deposit;* the nature of which not being generally understood, the following particular explanation may not be unacceptable.

Smith's Wealth of Nations. Book IV. chap. iii.

The currency of a great state, such as Britain, generally consists almost entirely of its own coin. Should this currency, therefore, be at any time worn, clipt, or otherwise degraded below its standard value the state by a reformation of its coin can effectually re-establish its currency. But the currency of a small state, such as Genoa or Hamburgh, can seldom consist altogether in its own coin, but must be made up in a great measure, of the coins of all the neighbouring states with which its inhabitants have a continual intercourse. Such a state, therefore, by reforming its coin, will not always be able to reform its currency. If foreign bills of exchange are paid in this currency, the uncertain value of any sum, of what is in its own nature so uncertain, must render the exchange always very much against such a state, its currency being, in all foreign states necessarily valued even below what it is worth. In order to remedy the inconvenience to which this disadvantageous exchange must have subjected their merchants, such small states, when they began to attend to the interest of trade, have frequently enacted, that foreign bills of exchange of a certain value should be paid, not in common currency, but by an order upon, or by a transfer in the books of, a certain bank, established upon the credit and under the protection of the state; this bank being always obliged to pay, in good and true money, exactly according to the standard of the state. The banks of Venice, Genoa, Amsterdam, Hamburgh, and Nuremberg, seem to have been originally established with this view, though some of them may have afterwards been made subservient to other purposes. The money of such banks, being better than the common currency of the country, necessarily bore an agio, which was greater or smaller, according as the currency was supposed to be more or less degraded below the standard of the state. The agio of the bank of Hamburgh, for example, which is said to be commonly about 14 *per cent.* is the supposed difference between the good standard money of the state, and the clipt, worn, and diminished currency poured into it from all the neighbouring states.

Before 1609, the great quantity of clipt and worn foreign coin, which the extensive trade of Amsterdam brought from all parts of Europe, reduced the value of its currency about 9 *per cent.* below that of good money fresh from the mint. Such money no sooner appeared, than it was melted down or carried away, as it always is in such circumstances. The merchants, with plenty of currency, could not always find a sufficient quantity of good money to pay their bills of exchange; and the value of those bills, in spite of several regulations which were made to prevent it, became in a great measure uncertain. In order to remedy these inconveniences, a bank was established in 1609 under the guarantee of the city. The bank received both foreign coin, and the light and worn coin of the country, at its real and intrinsic value in the good standard money of the country, deducting only so much as was necessary for defraying the expence of coinage, and the other necessary expence of management. For the value which remained after this small deduction was made, it gave a credit in its books. This credit was called *bank-money*; which, as it represented money exactly according to the standard of the mint, was always of the same real value, and intrinsically worth more than current money. It was at the same time enacted, that all bills drawn upon or negociated at Amsterdam of the value of 600 gilders and upwards should be paid in bank-money, which at once took away all uncertainty in the value of those bills. Every merchant, in consequence of this regulation, was obliged to keep an account with the bank in order to pay his foreign bills of exchange, which necessarily occasioned a certain demand for bank-money.

Bank of Amsterdam, one of the most famous.

Its institution, regulation, utility, &c.

Bank-money, over and above both its intrinsic superiority to currency, and the additional value which this demand necessarily gives it, has likewise some other advantages. It is secure from fire, robbery, and other accidents; the city of Amsterdam is bound for it; it can be paid away by a simple transfer, without the trouble of counting, or the risk of transporting it from one place to another. In consequence of those different advantages, it seems from the beginning to have borne an agio; and it is generally believed that all the money originally deposited in the bank was allowed to remain there, nobody caring to demand payment of a debt which he could sell for a premium in the market. Besides, this money could not be brought from those coffers, as it will appear by and by, without previously paying for the keeping.

Those deposits of coin, or which the bank was bound to restore in coin, constituted the original capital of the bank, or the whole value of what was represented by what

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what is called *Bank-money*. At present they are supposed to constitute but a very small part of it. In order to facilitate the trade in bullion, the bank has been for these many years in the practice of giving credit in its books upon deposits of gold and silver bullion. This credit is generally about 5 *per cent.* below the mint price of such bullion. The bank grants at the same time what is called a *recipice* or receipt, intitling the person who makes the deposit, or the bearer, to take out the bullion again at any time within six months, upon re-transferring to the bank a quantity of bank-money equal to that for which credit had been given in its books when the deposit was made, and upon paying ¼ *per cent.* for the keeping if the deposit was in silver, and ½ *per cent.* if it was in gold; but at the same time declaring, that in default of such payment, and upon the expiration of this term, the deposit should belong to the bank at the price at which it had been received, or for which credit had been given in the transfer books. What is thus paid for the keeping of the deposit may be considered as a sort of warehouse rent; and why this warehouse rent should be so much dearer for gold than for silver, several different reasons have been assigned. The fineness of gold, it has been said, is more difficult to be ascertained than that of silver. Frauds are more easily practised, and occasion a greater loss in the more precious metal. Silver, besides, being the standard metal, the state, it has been said, wishes to encourage more the making of deposits of silver than of those of gold.

Deposits of bullion are most commonly made when the price is somewhat lower than ordinary; and they are taken out again when it happens to rise. In Holland the market price of bullion is generally above the mint price, for the same reason that it was so in England before the late reformation of the gold coin. The difference is said to be commonly from about six to sixteen stivers upon the mark, or eight ounces of silver of eleven parts fine and one part alloy. The bank-price, or the credit which the bank gives for deposits of such silver (when made in foreign coin, of which the fineness is well known and ascertained, such as Mexico dollars), is 22 gilders the mark; the mint price is about 23 gilders; and the market-price is from 23 gilders six to 23 gilders sixteen stivers, or from 2 to 3 *per cent.* above the mint-price. The proportions between the bank-price, the mint-price, and the market-price, of gold bullion are nearly the same. A person can generally sell his receipt for the difference between the mint-price of bullion and the market-price. A receipt for bullion is almost always worth something; and it very seldom happens, therefore, that any body suffers his receipt to expire, or allows his bullion to fall to the bank at the price at which it had been received, either by not taking it out before the end of the six months, or by neglecting to pay the ¼ or ½ *per cent.* in order to obtain a new receipt for another six months. This, however, though it seldom happens, is said to happen sometimes, and more frequently with regard to gold than with regard to silver, on account of the higher warehouse-rent which is paid for the keeping of the more precious metal.

The person who by making a deposit of bullion obtains both a bank-credit and a receipt, pays his bills of exchange as they become due with his bank-credit; and either sells or keeps his receipt, according as he judges that the price of bullion is likely to rise or to fall. The receipt and the bank-credit seldom keep long together, and there is no occasion that they should. The person who has a receipt, and who wants to take out bullion, finds always plenty of bank-credits, or bank money to buy at the ordinary price; and the person who has bank-money, and wants to take out bullion, finds receipts always in equal abundance.

The owners of bank-credits and the holders of receipts constitute two different sorts of creditors against the bank. The holder of a receipt cannot draw out the bullion for which it is granted, without re-assigning to the bank a sum of bank-money equal to the price at which the bullion has been received. If he has no bank-money of his own, he must purchase it of those who have it. The owner of bank-money cannot draw out bullion without producing to the bank receipts for the quantity which he wants. If he has none of his own, he must buy them of those who have them. The holder of a receipt, when he purchases bank-money, purchases the power of taking out a quantity of bullion, of which the mint-price is 5 *per cent.* above the bank-price. The agio of 5 *per cent.* therefore, which he commonly pays for it, is paid, not for an imaginary, but for a real value. The owner of bank-money, when he purchases a receipt, purchases the power of taking out a quantity of bullion, of which the market-price is commonly from 2 to 3 *per cent.* above the mint-price. The price which he pays for it, therefore, is paid likewise for a real value. The price of the receipt, and the price of the bank-money, compound or make up between them the full value or price of the bullion.

Upon deposits of the coin current in the country, the bank grants receipts likewise as well as bank-credits; but those receipts are frequently of no value, and will bring no price in the market. Upon ducatoons, for example, which in the currency pass for three gilders three stivers each, the bank gives a credit of three gilders only, or 5 *per cent.* below their current value. It grants a receipt likewise intitling the bearer to take out the number of ducatoons deposited at any time within six months, upon paying ¼ *per cent.* for the keeping. This receipt will frequently bring no price in the market. Three gilders bank-money generally sell in the market for three gilders three stivers, the full value of the ducatoons if they were taken out of the bank; and before they can be taken out, ¼ *per cent.* must be paid for the keeping, which would be mere loss to the holder of the receipt. If the agio of the bank, however, should at any time fall to 3 *per cent.* such receipts might bring some price in the market, and might sell for 1¾ *per cent.* But the agio of the bank being now generally about 5 *per cent.* such receipts are frequently allowed to expire, or, as they express it, to fall to the bank. The 5 *per cent.* which the bank gains, when deposits either of coin or bullion are allowed to fall to it, may be considered as the warehouse rent for the perpetual keeping of such deposits.

The sum of bank money for which the receipts are expired must be very considerable. It must comprehend the whole original capital of the bank, which, it is generally supposed, has been allowed to remain there from the time it was first deposited, nobody caring

Bank. caring either to renew his receipt or to take out his deposit, as, for the reasons already assigned, neither the one nor the other could be done without loss. But whatever may be the amount of this sum, the proportion which it bears to the whole mass of bank-mony is supposed to be very small. The bank of Amsterdam has for these many years past been the great warehouse of Europe for bullion, for which the receipts are very seldom allowed to expire, or, as they express it, to fall to the bank. The far greater part of the bank-money, or of the credits upon the books of the bank, is supposed to have been created, for these many years past, by such deposits which the dealers in bullion are continually both making and withdrawing.

No demand can be made upon the bank but by means of a recipice or receipt. The smaller mass of bank-money, for which the receipts are expired, is mixed and confounded with the much greater mass for which they are still in force; so that, though there may be a considerable sum of bank-money for which there are no receipts, there is no specific sum or portion of it which may not at any time be demanded by one. The bank cannot be debtor to two persons for the same thing; and the owner of bank-money who has no receipt cannot demand payment of the bank till he buys one. In ordinary and quiet times, he can find no difficulty in getting one to buy at the market price, which generally corresponds with the price at which he can sell the coin or bullion it intitles him to take out of the bank.

It might be otherwise during a public calamity; an invasion, for example, such as that of the French in 1672. The owners of bank-money being then all eager to draw it out of the bank, in order to have it in their own keeping, the demand for receipts might raise their price to an exorbitant height. The holders of them might form extravagant expectations, and, instead of 2 or 5 *per cent.* demand half the bank-money for which credit had been given upon the deposits that the receipts had respectively been granted for. The enemy, informed of the constitution of the bank, might even buy them up in order to prevent the carrying away of the treasure. In such emergencies, the bank, it is supposed, would break through its ordinary rule of making payment only to the holders of receipts. The holders of receipts, who had no bank-money, must have received within 2 or 3 *per cent.* of the value of the deposit for which their respective receipts had been granted. The bank, therefore, it is said, would in this case make no scruple of paying, either with money or bullion, the full value of what the owners of bank-money who could get no receipts were credited for in its books; paying at the same time 2 or 3 *per cent.* to such holders of receipts as had no bank-money, that being the whole value which in this state of things could justly be supposed due to them.

Even in ordinary and quiet times it is the interest of the holders of receipts to depress the agio, in order either to buy bank-money (and consequently the bullion which their receipts would then enable them to take out of the bank) so much cheaper, or to sell their receipts to those who have bank-money, and who want to take out bullion, so much dearer; the price of a receipt being generally equal to the difference between the market-price of bank-money and that of the coin or bullion for which the receipt had been granted. It is the inetrest of the owners of bank-money on the contrary, to raise the agio, in order either to sell their bank-money so much dearer, or to buy a receipt so much cheaper. To prevent the stock-jobbing tricks which those opposite interests might sometimes occasion, the bank has of late years come to a resolution to sell at all times bank-money for currency, at 5 *per cent.* agio, and to buy it again at 4 *per cent.* agio. In consequence of this resolution, the agio can never either rise above 5 or sink below 4 *per cent.* and the proportion between the market-price of the bank and that of current money is kept at all times very near to the proportion between their intrinsic values. Before this resolution was taken, the market-price of money used sometimes to rise so high as 9 *per cent.* agio, and sometimes to sink so low as par, according as opposite interests happened to influence the market.

The bank of Amsterdam professes to lend out no part of what is deposited with it, but, for every gilder for which it gives credit in its books, to keep in its repositories the value of a gilder either in money or bullion. That it keeps in its repositories all the money or bullion for which there are receipts in force, for which it is at all times liable to be called upon, and which, in reality, is continually going from it and returning to it again, cannot well be doubted. But whether it does so likewise with regard to that part of its capital for which the receipts are long ago expired, for which in ordinary and quiet times it cannot be called upon, and which in reality is very likely to remain with it for ever, or as long as the States of the United Provinces subsist, may perhaps appear more uncertain. At Amsterdam, however, no part of faith is better established, than that for every gilder circulated as bank-money there is a correspondent gilder in gold and silver to be found in the treasure of the bank. The city is guarantee that it should be so. The bank is under the direction of the four reigning burgomasters, who are changed every year. Each new set of burgomasters visits the treasure, compares it with the books, receives it upon oath, and delivers it over, with the same awful solemnity, to the set which succeeds it; and in that sober and religious country oaths are not yet disregarded. A rotation of this kind seems alone a sufficient security against any practices which cannot be avowed. Amidst all the revolutions which faction has ever occasioned in the government of Amsterdam, the prevailing party has at no time accused their predecessors of infidelity in the administration of the bank. No accusation could have affected more deeply the reputation and fortune of the disgraced party; and if such an accusation could have been supported, we may be assured that it would have been brought. In 1672, when the French king was at Utrecht, the bank of Amsterdam paid so readily as left no doubt of the fidelity with which it had observed its engagements. Some of the pieces which were then brought from its repositories appeared to have been scorched with the fire which happened in the town-house soon after the bank was established. Those pieces, therefore, must have lain there from that time.

What may be the amount of the treasure in the bank is a question which has long employed the speculations of the curious. Nothing but conjecture can be offered concerning it. It is generally reckoned, that there are about 2000 people who keep accounts with the

the bank; and allowing them to have, one with another, the value of 1500l. lying upon their respective accounts, (a very large allowance), the whole quantity of bank-money, and consequently of treasure in the bank, will amount to 3,000,000l. or, at 21 gilders the pound Sterling, 33,000,000 of gilders; a great sum, and sufficient to carry on a very extensive circulation, but vastly below the extravagant ideas which some people have formed of this treasure.

The city of Amsterdam derives a considerable revenue from the bank. Besides what may be called the *warehouse-rent* above mentioned, each person, upon first opening an account with the bank, pays a fee of 10 gilders; and for every new account, 3 gilders 3 stivers; for every transfer, 2 stivers; and if the transfer is for less than 300 gilders, 6 stivers, in order to discourage the multiplicity of small transactions. The person who neglects to balance his accounts twice in the year forfeits 25 gilders. The person who orders a transfer for more than is upon his account, is obliged to pay 3 *per cent.* for the sum overdrawn, and his order is set aside into the bargain. The bank is supposed too to make a considerable profit by the sale of the foreign coin or bullion which sometimes falls to it by the expiring of receipts, and which is always kept till it can be sold with advantage. It makes a profit likewise by selling bank-money at 5 *per cent.* agio, and buying it at 4. These different emoluments amount to a good deal more than what is necessary for paying the salaries of officers, and defraying the expence of management. What is paid for the keeping of bullion upon receipts, is alone supposed to amount to a neat annual revenue of between 150,000 and 200,000 gilders. Public utility, however, and not revenue, was the original object of this institution. Its object was to relieve the merchants from the inconvenience of a disadvantageous exchange. The revenue which has arisen from it was unforeseen and may be considered as accidental.

Bank, in sea-affairs denotes an elevation of the ground or bottom of the sea, so as sometimes to surmount the surface of the water, or at least to leave the water so shallow as usually not to allow a vessel to remain a-flote over it.—In this sense, *bank* amounts to much the same as flat, shoal, &c. There are banks of sand, and others of stone, called also *shelves*, or *rocks*. In the north sea they also speak of banks of ice, which are large pieces of that matter floating.

BANKER, a person who traffics and negociates in money; who receives and remits money from place to place by commission from correspondents, or by means of bills or letters of exchange, &c.

The ancient bankers were called *argentarii*, and *nummularii*; by the Greeks, τραπεζιται, κολλυβιςαι, and αργυραμοιβοι. Their chief business was to put out the money of private persons to interest: they had their boards and benches, for this purpose, in all the markets and public places, where they took in the money from some, to lend it to others.

BANKING, the making of banks to oppose the force of the sea, rivers, or the like, and secure the land from being overflowed thereby. With respect to the water which is to be kept out, this is called *banking*; with respect to the land, which is hereby to be defended, *imbanking*.

Banking is also applied to the keeping a bank, or the employment of a banker. Banking, in this sense, signifies the trading in money, or remitting it from place to place, by means of bills of exchange. This answers to what the French call *faire le banque*. In France, every body is allowed to bank, whether merchant or not; even foreigners are indulged in this kind of traffic. In Italy, banking does not derogate from nobility, especially in the republic states; whence it is, that most of the younger sons of great families engage in it. In reality, it was the nobility of Venice and Genoa, that, for a long time, were the chief bankers in the other countries of Europe.

BANKISH, a province of the Mogul's dominions, in the north part of the Hither India, lying south-west of the province of Cassimere.

BANKRUPT, (*bancus ruptus*), is so called, because, when the bank or stock is broken or exhausted, the owner is said to be a *bankrupt*. And this word *bankrupt* is derived from the French *banqueroute*, which signifies a breaking or failing in the world: *banque* in French is as much as *mensa* in Latin, and *route* is the same as *vestigium*; and this term is said to be taken originally from the Roman *mensarii*, which were set in public places; and when a tradesman slipped away, with an intention to deceive his creditors, he left only some *vestigia* or signs of his table or shop behind him. But a bankrupt with us, from the several descriptions given of him in our statute-law, may be defined "a trader, who secretes himself, or does certain other acts tending to defraud his creditors." For the better understanding of this article, it will be proper to consider, 1. *Who* may become a bankrupt: 2. What *acts* make a bankrupt: 3. The *proceedings* on a commission of bankruptcy: and, 4. In what manner an estate in goods and chattels may be *transferred* by bankruptcy.—But of these, the two last being treated under the article Commission *of Bankruptcy*, the two first only belong to this place.

1. A bankrupt was formerly considered merely in the light of a criminal or offender; and in this spirit we are told by Sir Edward Coke, that we have fetched as well the name, as the wickedness, of bankrupts from foreign nations. But at present the laws of bankruptcy are considered as laws calculated for the benefit of trade, and founded on the principles of humanity as well as justice; and to that end they confer some privileges, not only on the creditors, but also on the bankrupt or debtor himself. On the creditors; by compelling the bankrupt to give up all his effects to their use, without any fraudulent concealment: on the debtor; by exempting him from the rigor of the general law, whereby his person might be confined at the discretion of his creditor, though in reality he has nothing to satisfy the debt; whereas the law of bankrupts, taking into consideration the sudden and unavoidable accidents to which men in trade are liable, has given them the liberty of their persons, and some pecuniary emoluments, upon condition they surrender up their whole estate to be divided among their creditors.

In this respect the legislature seems to have attended to the example of the Roman law. We mean not the terrible law of the twelve tables; whereby the creditors might cut the debtor's body into pieces, and each of them take his proportionable share: if indeed that law, *de debitore in partes secando*, is to be understood in so very butcherly a light: which many learned men have with

Blackst. Comm. II. 472, &c.

Bankrupt. with reason doubted. Nor do we mean those less inhuman laws (if they may be called so, as *their* meaning is indisputably certain), of imprisoning the debtor's person in chains; subjecting him to stripes and hard labour, at the mercy of his rigid creditor; and sometimes selling him, his wife and children, to perpetual foreign slavery *trans Tiberim* (A): an oppression, which produced so many popular insurrections, and secessions to the *mons sacer*. But we mean the law of cession, introduced by the Christian emperors; whereby, if a debtor *ceded* or yielded up all his fortune to his creditors, he was secured from being dragged to a gaol, "*omni quoque corporali cruciatu semoto.*" For, as the emperor justly observes, "*inhumanum erat spoliatum fortunis suis in solidum damnari.*" Thus far was just and reasonable: but as the departing from one extreme is apt to produce its opposite, we find it afterwards enacted, that if the debtor by any unforeseen accident was reduced to low circumstances, and would swear that he had not sufficient left to pay his debts, he should not be compelled to cede or give up even that which he had in his possession; a law which, under a false notion of humanity, seems to be fertile of perjury, injustice, and absurdity.

The laws of England, more wisely, have steered in the middle between both extremes: providing at once against the inhumanity of the creditor, who is not suffered to confine an honest bankrupt after his effects are delivered up, and at the same time taking care that all his just debts shall be paid, so far as the effects will extend. But still they are cautious of encouraging prodigality and extravagance by this indulgence to debtors: and therefore they allow the benefit of the laws of bankruptcy to none but actual traders; since that set of men are, generally speaking, the only persons liable to accidental losses, and to an inability of paying their debts, without any fault of their own. If persons in other situations of life run in debt without the power of payment, they must take the consequences of their own indiscretion, even though they meet with sudden accidents that may reduce their fortunes: for the law holds it to be an unjustifiable practice, for any person but a trader to encumber himself with debts of any considerable value. If a gentleman, or one in a liberal profession, at the time of contracting his debts, has a sufficient fund to pay them, the delay of payment is a species of dishonesty, and a temporary injustice to his creditor: and if, at such time, he has not sufficient fund, the dishonesty and injustice is the greater. He cannot therefore murmur, if he suffers the punishment which he has voluntarily drawn upon himself. But in mercantile transactions the case is far otherwise. Trade cannot be carried on without mutual credit on both sides: the contracting of debts is therefore here not only justifiable but necessary. And if by accidental calamities, as by the loss of a ship in a tempest, the failure of brother traders, or by the non-payment of persons out of trade, a merchant or trader becomes incapable of discharging his own debts, it is his misfortune and not his fault. To the misfortunes therefore of debtors, the law has given a compassionate remedy, but denied it to their faults: since, at the same time that it provides for the security of commerce, by enacting that every considerable trader may be declared a bankrupt, for the benefit of his creditors as well as himself, it has also, to discourage extravagance, declared that no one shall be capable of being made a bankrupt, but only a trader; nor capable of receiving the full benefit of the statutes, but only an industrious trader.

In the interpretation of the several statutes made concerning English bankrupts, *, it hath been held, that buying only, or selling only, will not qualify a man to be a bankrupt; but it must be both buying and selling, and also getting a livelihood by it: as, by exercising the calling of a merchant, a grocer, a mercer, or, in one general word, a *chapman*, who is one that buys and sells any thing. But no handicraft occupation (where nothing is bought or sold, and therefore an extensive credit, for the stock in trade, is not necessary to be had) will make a man a regular bankrupt; as that of a husbandman, a gardener, and the like, who are paid for their work and labour. Also an inn-keeper cannot, as such be a bankrupt: for his gain or livelihood does not arise from buying and selling in the way of merchandize, but greatly from the use of his rooms and furniture, his attendance, and the like: and though he may buy corn and victuals, to sell again at a profit, yet that no more makes him a trader, than a schoolmaster or other person is, that keeps a boarding-house, and makes considerable gains by buying and selling what he spends in the house, and such a one is clearly not within the statutes. But where persons buy goods, and make them up into saleable commodities, as shoemakers, smiths, and the like; here, though part of the gain is by bodily labour, and not by buying and selling, yet they are within the statutes of bankrupts; for the labour is only in melioration of the commodity, and rendering it more fit for sale.

* 34 Hen. VIII. c. 4. 13 Eliz. c. 7. 21 Jac. I. c. 19. 5 Geo. II. c. 30.

2. To learn what the *acts* of bankruptcy are which render a man a bankrupt, we must consult the several statutes, and the resolutions formed by the courts thereon. Among these may therefore be reckoned, 1. Departing from the realm, whereby a man withdraws himself from the jurisdiction and coërcion of the law, with an intent to defraud his creditors. 2. Departing from his own house, with intent to secrete himself and avoid his creditors. 3. Keeping in his own house, privately, (except for just and necessary cause), so as not to be seen or spoken with by his creditors; which is likewise construed to be an intention to defraud his creditors, by avoiding the process of the law. 4. Procuring or suffering himself willingly to be arrested, or outlawed, or imprisoned, without just and lawful cause; which is likewise deemed an attempt to defraud his creditors. 5. Procuring his money, goods, chattels, and effects, to be attached or sequestrated by any legal process; which is another plain and direct endeavour to disappoint his creditors of their security. 6. Making any fraudulent conveyance to a friend, or secret

(A) In Pegu, and the adjacent countries in East India, the creditor is entitled to dispose of the debtor himself, and likewise of his wife and children: insomuch that he may even violate with impunity, the chastity of the debtor's wife; but then, by so doing, the debt is understood to be discharged.

fecret truftee, of his lands, tenements, goods, or chattels; which is an act of the fame fufpicious nature with the laft. 7. Procuring any protection, not being himfelf privileged by parliament, in order to fcreen his perfon from arrefts; which alfo is an endeavour to elude the juftice of the law. 8. Endeavouring, or defiring, by any petition to the king, or bill exhibited in any of the king's courts againft any creditors, to compel them to take lefs than their juft debts; or to procraftinate the time of payment, originally contracted for; which are an acknowledgment of either his poverty or his knavery. 9. Lying in prifon for two months, or more, upon an arreft or other detention for debt, without finding bail, in order to obtain his liberty. For the inability to procure bail argues a ftrong deficiency in credit, owing either to his fufpected poverty, or his ill character; and his neglect to do it, if able, can arife only from a fraudulent intention: in either of which cafes, it is high time for his creditors to look to themfelves, and compel a diftribution of his effects. 10. Efcaping from prifon after an arreft for a juft debt of L.100, or upwards. For no man would break prifon, that was able and defirous to procure bail; which brings it within the reafon of the laft cafe. 11. Neglecting to make fatisfaction for any juft debt to the amount of L.100, within two months after fervice of legal procefs, for fuch a debt, upon any trader having privilege of parliament.

Thefe are the feveral acts of bankruptcy exprefsly defined by the ftatutes relating to this article; which being fo numerous, and the whole law of bankrupts being an innovation on the common law, our courts of juftice have been tender of extending or multiplying acts of bankruptcy by any conftruction or implication. And therefore Sir John Holt held, that a man's removing his goods privately to prevent their being feized in execution, was no act of bankruptcy. For the ftatutes mention only fraudulent gifts to third perfons, and procuring them to be feized by fham procefs, in order to defraud creditors; but this, though a palpable fraud, yet, falling within neither of thofe cafes, cannot be adjudged an act of bankruptcy. So alfo it has been determined exprefsly, that a banker's ftopping or refufing payment is no act of bankruptcy: for it is not within the defcription of any of the ftatutes; and there may be good reafons for his fo doing, as fufpicion of forgery and the like: and if, in confequence of fuch a refufal, he is arrefted, and puts in bail, ftill it is no act of bankruptcy; but if he goes to prifon, and lies there two months, then, and not before, is he become a bankrupt.

As to the confequences refulting from the unhappy fituation of a bankrupt, fee the article *Commsssion of Bankruptcy*.

BANKS (John), a dramatic writer, was bred to the law, and belonged to the fociety of Gray's Inn; but this profeffion not fuiting his natural difpofition, he quitted it for the fervice of the mufes. Here, however, he found his rewards by no means adequate to his deferts. His emoluments at the beft were precarious, and the various fucceffes of his pieces too feelingly convinced him of the error in his choice. This, however, did not prevent him from purfuing with cheerfulnefs the path he had taken; his thirft of fame, and warmth of poetic enthufiafm, alleviating to his imagination many difagreeable circumftances into which indigence, the too frequent attendant on poetical purfuits, frequently threw him. His turn was entirely to tragedy, his merit in which is of a peculiar kind. For at the fame time that his language muft be confeffed to be extremely unpoetical, and his numbers uncouth and unharmonious; nay, even his characters very far from being ftrongly marked or diftinguifhed, and his epifodes extremely irregular: yet it is impoffible to avoid being deeply affected at the reprefentation, and even at the reading of his tragic pieces. This is owing in the general to an happy choice of his fubjects; which are all borrowed from hiftory, either real or romantic; and indeed the moft of them from circumftances in the annals of our own country, which, not only from their being familiar to our continual recollection, but even from their having fome degree of relation to ourfelves, we are are apt to receive with a kind of partial prepoffeffion, and a predetermination to be pleafed. He has conftantly chofen as the bafis of his plays fuch tales as were in themfelves and their well-known cataftrophes moft truly adapted to the purpofes of the drama. He has indeed but little varied from the ftrictnefs of hiftorical facts; yet he feems to have made it his conftant rule to keep the fcene perpetually alive, and never fuffer the characters to droop. His verfe is not poetry, but profe run mad. Yet will the falfe gem fometimes approach fo near in glitter to the true one, at leaft in the eyes of all but the real connoiffeurs (and how fmall a part of an audience are to be ranked in this clafs will need no ghoft to inform us), that bombaft will frequently pafs for the true fublime; and where it is rendered the vehicle of incidents in themfelves affecting, and in which the heart is apt to intereft itfelf, it will perhaps be found to have a ftronger power on the human paffions than even that property to which it is in reality no more than a bare fuccedaneum. And from thefe principles it is that we muft account for Mr Banks's writings having in the general drawn more tears from, and excited more terror in, even judicious audiences, than thofe of much more correct and more truly poetical authors. The tragedies he has left behind are, 1. *Albion Queens*. 2. *Cyrus the Great*. 3. *Deftruction of Troy*. 4. *Innocent Ufurper*. 5. *Ifland Queens*. This is only the Albion Queens altered. 6. *Rival Kings*. 7. *Virtue betrayed*. 8. *Unhappy Favourite*. The Albion Queens was rejected by the managers in 1604; but was acted by Queen Anne's command in 1706, with great applaufe, and has been feveral times revived. The Unhappy favourite continued till very lately a ftock tragedy at the theatres: but gives way at prefent to the latter tragedies from the fame ftory, by Jones and Brooke.—Neither the time of the birth nor that of the death of this author, are afcertained. His remains, however, lie interred in the church of St James's, Weftminfter.

BANKS's island, a fmall ifland in the South Sea difcovered by Captain Cook in 1770, in S. Lat. 53. 32. W. Long. 186. 30. It is of a circular figure; and about 24 leagues in compafs: it is fufficiently high to be feen at the diftance of 21 or 15 leagues; and the land has a broken irregular furface, with the appearance of barrennefs rather than fertility. It is, however, inhabited, as fome ftraggling favages were obferved upon it.

BANKSIA, in botany; a genus of the monogynia order, belonging to the tetrandia class of plants. The amentum is scaly, the corolla consists of four petals; the antheræ are in the cavity of the folds, and fossile; the capsule is bivalvular; and the seed is solitary, and bipartic. There are four species, the serrata, integrifolia, ericæ folia, and dentata, all natives of New Holland.

BANN, or BAN (from the Brit. *ban*, i. e. clamour), is a proclamation or public notice; any public summons or edict, whereby a thing is commanded or forbidden. It is a word ordinary among the feudists; and there is both *banus* and *banum*, which signify two several things.—The word *banns* is particularly used in England in publishing matrimonial contracts; which is done in the church before marriage, to the end that if any persons can speak against the intention of the parties, either in respect of kindred, precontract, or for other just cause, they may take their exception in time, before marriage is consummated; and in the canon law, Bannæ *sunt proclamationes sponsi et sponæ in ecclesiis fieri solitæ*. But there may be a faculty or licence for the marriage, and then this ceremony is omitted; and ministers are not to celebrate matrimony between any persons without a licence, except the banns have been first published three several times, upon pain of suspension, &c. Can. 62.

The use of matrimonial banns is said to have been first introduced in the Gallican church, though something like it obtained even in the primitive times; and it is this that Tertullian is supposed to mean by *trinundina promulgatio*. The council of Lateran first extended, and made the usage general. By the ordinance of Blois, no person could validly contract marriage, without a preceding proclamation of three banns; nor could any person whatever be dispensed with, except for the two last. But the French themselves have abated much of this severity; and only minors are now under an absolute necessity of submitting to the formality of banns. For majors, or those of age, after publication of the first banns, the two latter are easily bought off.

BANN, is also used to denote proscription or banishment for a crime proved; because anciently published by sound of trumpet; or, as Vossius thinks, because those who did not appear at the abovementioned summons, were punished by proscription. Hence, *to put a prince under the bann of the empire*, is to declare him divested of all his dignities. The sentence only denotes an interdict of all intercourse, and offices of humanity, with the offender; the form of which seems taken from that of the Romans, who banished persons by forbidding them the use of fire and water. Sometimes also cities are put under the imperial bann; that is, stripped of their rights and privileges.

BANN also denotes a pecuniary mulct, or penalty, laid on a delinquent for offending against a bann.

BANN, or BANNUS, a title anciently given to the governor or viceroy of Croatia, Dalmatia, and Sclavonia.

Episcopal BANN, *(Bannus Episcopalis)*, a mulct paid to the bishop by those guilty of sacrilege and other crimes.

BANN, is also used for a solemn anathema, or excommunication, attended with curses, &c. In this sense we read of *papal banns*, &c.

BANN, in military affairs, a proclamation made in the army by beat of drum, sound of trumpet, &c. requiring the strict observance of discipline, either for the declaring a new officer, or punishing an offender.

BANNER denotes either a square flag, or the principal standard belonging to a prince.

We find a multiplicity of opinions concerning the etymology of the word *banner*; some deriving it from the Latin *bandum*, "a band or flag;" others from the word *bann*, "to summon the vassals to appear in arms;" others again from the German *ban*, "a field or tenement," because landed men alone were allowed a banner; and, finally, there are some who think it is a corruption of *panniere*, from *pannus*, "cloth," because banners were originally made of cloth.

The BANNER *of France*, was the largest and richest of all the flags borne by the ancient kings in their great military expeditions. St Martin's cap was in use 600 years as the banner of France; it was made of taffety, painted with the image of that saint, and laid one or two days on his tomb to prepare it for use. About the year 1100 came in a more pompous apparatus. The banner royal was fastened to the top of a mast, or some tall tree, planted on a scaffold, borne on a carriage drawn by oxen, covered with velvet housings, decorated with devices or cyphers of the prince reigning. At the foot of the tree was a priest who said mass early every morning. Ten knights mounted guard on the scaffold night and day, and as many trumpets at the foot of the tree never ceased flourishing, to animate the troops. This cumbersome machine, the mode of which was brought from Italy, continued in use about 130 years. Its post was in the centre of the army. And here it was that the chief feats were performed, to carry off and defend the royal banner; for there was no victory without it, nor was any army reputed vanquished till they had lost their banner.

BANNERETS, an ancient order of knights or feudal lords; who possessing several large fees, led their vassals to battle under their own flag or banner, when summoned thereto by the king. The word seems formed from *banner*, "a square flag;" or from *band*, which anciently denoted a flag.—Bannerets are also called in ancient writers *milites vexilliferi*, and *vexillarii bannerarii*, *bannarii*, *banderisii*, &c.

Anciently there were two kinds of knights, *great* and *little*; the first whereof were called *bannerets*, the second *bachelors*; the first composed the upper, the second the middle, nobility.

The banneret was a dignitary allowed to march under his own flag, whereas the *bachelarius eques* followed that of another. To be qualified for a banneret, one must be a gentleman of family, and must have a power to raise a certain number of armed men, with estate enough to subsist at least 28 or 30 men. This must have been very considerable in those days; because each man, besides his servant, had two horsemen to wait on him armed, the one with a cross-bow, the other with a bow and hatchet. As he was not allowed to be a baron who had not above 13 knights fees, so he was not admitted to be a banneret if he had less than 10.

Banneret, according to Spelman, was a middle order between a baron and a ſimple knight; called ſometimes alſo *vexillarius minor*, to diſtinguiſh him from the greater, that is, from the baron, to whom alone properly belonged the *jus vexilli*, or privilege of the ſquare flag. Hence the banneret was alſo called *bannerettus, quaſi baro minor;* a word frequently uſed by Engliſh writers in the ſame ſenſe as banneret was by the French, though neither of them occur before the time of Edward II.

Some will have bannerets to have originally been perſons who had ſome portion of a barony aſſigned them; and enjoyed it under the title of *baro proximus*, and that with the ſame prerogatives as the baron himſelf. Some, again, find the origin of bannerets in France, others in Brittany, others in England. Theſe laſt attribute the inſtitution of bannerets to Conan, lieutenant of Maximus, who commanded the Roman legions in England under the empire of Gratian in 383. This general, ſay they, revolting, divided England into 40 cantons, and in theſe cantons diſtributed 40 knights; to whom he gave a power of aſſembling, on occaſion, under their ſeveral banners, as many of the effective men as were found in their reſpective diſticts: whence they are called *bannerets*. However this be, it appears from Froiſſart, &c. that anciently ſuch of the military men as were rich enough to raiſe and ſubſiſt a company of armed men, and had a right to do ſo, were called *bannerets*. Not, however, that theſe qualifications rendered them knights, but only bannerets; the appellation of *knight* being only added thereto, becauſe they were ſimple knights before.

Bannerets were ſecond to none but knights of the garter. They were reputed the next degree below the nobility; and were allowed to bear arms with ſupporters, which none elſe may under the degree of a baron. In France, it is ſaid, the dignity was hereditary; but in England it died with the perſon that gained it. The order dwindled on the inſtitution of baronets by King James I. and at length became extinct. The laſt perſon created banneret was Sir John Smith, made ſo after Edghill-fight, for reſcuing the ſtandard of King Charles I.

The form of the banneret's creation was this. On a day of battle, the candidate preſented his flag to the king or general; who, cutting off the train or ſkirt thereof, and making it a ſquare, returned it again, the proper banner of bannerets; who are hence ſometimes called *knights of the ſquare flag*. There ſeems to have been bannerets created either in a different manner, or by others than the ſovereign; ſince King James, in the patent of baronets, gives them precedence to all knights bannerets, except ſuch as are created by the king himſelf in the field; which implies, either that there are ſome of this order created out of the field, or by inferior perſons.

Banneret is alſo the name of an officer or magiſtrate of Rome towards the cloſe of the 14th century.—The people of that city, and throughout the territory of the church, during the diſputes of the antipopes, had formed a kind of republican government; where the whole power was lodged in the hands of a magiſtrate called *ſenator*, and twelve heads of quarters called *bannerets*, by reaſon of the banners which each raiſed in his diſtrict.

BANNOCK, a kind of oat-cake, baked in the embers, or on a ſtone placed before the fire. It is common in the northern parts of Scotland.

BANNUM, in law, ſignifies the utmoſt bounds of a manor or town.

BANQUET, a feaſt or entertainment where people regale themſelves with pleaſant foods or fruits.

Banquet, in the menage, that ſmall part of the branch of a bridle that is under the eye; which being rounded like a ſmall rod, gathers and joins the extremities of the bit to the branch in ſuch a manner that the banquet is not ſeen, but covered by the cope, or that part of the bit that is next the branch.

Banquet-Line, an imaginary line drawn, in making a bit, along the banquet, and prolonged up or down, to adjuſt the deſigned force or weakneſs of the branch, in order to make it ſtiff or eaſy.

Banquet, or *Banquette*, in fortification, a little foot-bank, or elevation of earth, forming a path which runs along the inſide of a parapet, upon which the muſketeers get up, in order to diſcover the counterſcarp, or to fire on the enemy, in the moat or in the covert-way.

BANQUETING room or house. See Saloon. The ancient Romans ſupped in the atrium, or veſtibule, of their houſes; but, in after-times, magnificent ſaloons, or banqueting-rooms, were built, for the more commodious and ſplendid entertainment of their gueſts. Lucullus had ſeveral of theſe, each diſtinguiſhed by the name of ſome god; and there was a particular rate of expence appropriated to each. Plutarch relates with what magnificence he entertained Cicero and Pompey, who went with deſign to ſurpriſe him, by telling only a ſlave who waited, that the cloth ſhould be laid in the Apollo. The emperor Claudius, among others, had a ſplendid banqueting-room named *Mercury*. But every thing of this kind was outdone by the luſtre of that celebrated banqueting-houſe of Nero, called *domus aurea;* which, by the circular motion of its partitions and ceilings, imitated the revolution of the heavens, and repreſented the different ſeaſons of the year, which changed at every ſervice, and ſhowered down flowers, eſſences, and perfumes, on the gueſts.

BANSTICKLE, in ichthyology. See Gasterosteus.

BANTAM, a large town of the iſland of Java, in the Eaſt Indies, ſituated in E. Long. 105. 16. S. Lat. 6. 20. It is the capital of a kingdom of the ſame name, with a good harbour and fortified caſtle. It is divided into two towns ſeparated by a river, and one of them inhabited by the Chineſe. For its hiſtory, &c. ſee Java.

Bantam-work, a kind of painted or carved work, reſembling that of Japan, only more gaudy.

There are two ſorts of Bantam, as well as of Japan work. As, in the latter, ſome are flat, lying even with the black, and others high and emboſſed; ſo, in Bantam-work, ſome are flat, and others in-cut, or carved into the wood, as we find in many large ſcreens: with this difference, that the Japan artiſts work chiefly in gold and other metals; and thoſe of Bantam generally in colours, with a ſmall ſprinkling of gold here and there: for the flat Bantam-work is done in colours, mixed with gum-water, proper for the thing deſigned to be imitated. For the carved, or in-cut kind, the method of performing it is thus deſcribed by an ingenious

genious

Bantry ‖ Baptism.

genious artist: 1. The wood is to be primed with whiting and size, so often, till the primer lie near a quarter of an inch thick; then it is to be water-plained, *i. e.* rubbed with a fine wet cloth, and, some time after, rubbed very smooth, the blacks laid on, varnished up with a good body, and polished well, though with a gentle hand. This done, the design is to be traced out with vermilion and gum-water, exactly in the manner wherein it is intended to be cut; the figures, trees, buildings, &c. in their due proportion: then the graver is applied, with other tools of proper shapes, differing according to the workman's fancy: with these he cuts deep or shallow, as is found convenient, but never deeper than the whiting lies, the wood being never to feel the edge of the instrument. Lines, or parts of the black, are still to be left for the draperies, and other out-lines, and for the distinction of one thing from another; the rule being to cut where the white is, and leave the black untouched. The carving being finished, then take to the pencil, with which the colours are laid into the cut-work: after this, the gold is to be lain in those places which the design requires; for which purpose, a strong thick gum-arabic water is taken and laid with a pencil on the work; and, while this remains wet, leaf-gold is cut with a sharp smooth edged knife, in little pieces, shaped to the bigness and figure of the places where they are to be laid. These being taken up with a little cotton, they daub them with the same close to the gum-water, which affords a rich lustre. The work thus finished, they clear up the black with oil, taking care not to touch the colours. The European workmen ordinarily use brass-dust, which is less bright and beautiful.

BANTRY, a town of Ireland, in the county of Cork, and province of Munster. It is seated on a bay of the same name, in W. Long. 9. 15. N. Lat. 51. 30.

BAOBAB, the name given by Prosper Alpinus to the African calabash-tree, since called ADANSONIA. See that article.

BAPTISM, in matters of religion, the ceremony of washing; or a sacrament, by which a person is initiated into the Christian church.—The word is formed from the Greek βαπτιζω, of βαπτω *to dip*, or *wash*. Baptism is known, in ecclesiastical writers, by divers other names and titles. Sometimes it is called *palingenesia*, or *laver of regeneration;* sometimes *salus*, or *life and salvation;* sometimes σφραγις, *signaculum Domini*, and *signaculum fidei*, or *the seal of faith*; sometimes absolutely *mysterium*, and *sacramentum;* sometimes *the sacrament of faith;* sometimes *viaticum*, from its being administered to departing persons; sometimes *sacerdotium laici*, or *the lay priesthood*, because allowed, in cases of necessity, to be conferred by laymen: sometimes it is called the *great circumcision*, because it was imagined to succeed in the room of circumcision, and to be a seal of the Christian covenant, as that was the seal of the covenant made with Abraham: so, in regard that baptism had Christ for its author, and not man, it was anciently known by the name of Δωρον and χαρισμα Κυριȣ, *the gift of the Lord:* sometimes it was simply called Δωρον, without any other addition, by way of eminence, because it was both a gratuitous and singular gift of Christ: in reference to the making men complete members of Christ's body, the church, it had the name of Τελειωσις, and Τελειη, the *consecration* and *consummation;* because it gave men the perfection of Christians, and a right to partake of the Το Τελειον, which was *the Lord's Supper:* it had also the name of μυησις and μυςαγωγια, the *initiation*, because it was the admittance of men to all the sacred rites and mysteries of the Christian religion.

Various names given to baptism.

Bingham's Orig. Ecclef.

Baptism.

Its origin, &c.

Baptism has been supposed by many learned authors to have had its origin from the Jewish church, in which, as they maintain, it was the practice long before Christ's time, to baptize proselytes or converts to their faith, as part of the ceremony of their admission; a practice which, according to some, obtains among them to this day; a person turning Jew, is first circumcised, and, when healed, is bathed, or baptized in water, in presence of their rabbins; after which he is reputed a good Jew. Others, however, insist that the Jewish proselyte baptism is not by far so ancient, and that John the Baptist was the first administrator of baptism among the Jews. Of this opinion were Deylingius, J. G. Carpzovius, Boernerus, Wernsdorfius, Zeltnerus, Owen, Knatchbull, Jennings, Gill, and others.

Grotius is of opinion, that the rite of baptism had its original from the time of the deluge; immediately after which, he thinks, it was instituted in memory of the world having been purged by water. Some learned men think it was added to circumcision, soon after the Samaritan schism, as a mark of distinction to the orthodox Jews. Spencer, who is fond of deriving the rites of the Jewish religion from the ceremonies of the Pagans, lays it down as a probable supposition, that the Jews received the baptism of proselytes from the neighbouring nations, who were wont to prepare candidates for the more sacred functions of their religion, by a solemn ablution; that, by this affinity of sacred rites, they might draw the Gentiles to embrace their religion, and that the proselytes (in gaining of whom they were extremely diligent) might the more easily comply with the transition from Gentilism to Judaism. In confirmation of this opinion, he observes, first, that there is no divine precept for the baptism of proselytes, God having enjoined only the rite of circumcision for the admission of strangers into the Jewish religion. Secondly, that, among foreign nations, the Egyptians, Persians, Greeks, Romans, and others, it was customary that those who were to be initiated into their mysteries, or sacred rites, should be first purified by dipping their whole body in water. That learned writer adds, as a farther confirmation of his opinion, that the cup of blessing likewise, added to the paschal supper, seems plainly to have been derived from a pagan original: for the Greeks, at their feasts, had one cup called ποτηριον αγαθȣ δαιμονος, *the cup of the good dæmon or god*, which they drank at the conclusion of their entertainment, when the table was removed. Since, then, a rite of Gentile origin was added to one of the Jewish sacraments, viz. the passover, there can be no absurdity in supposing, that baptism, which was added to the other sacrament, namely circumcision, might be derived from the same source. In the last place, he observes, that Christ, in the institution of his sacraments, paid a peculiar regard to those rites which were borrowed from the Gentiles: for, rejecting circumcision and the paschal supper, he adopted into his religion baptism and the sacred cup; thus preparing the way for the conversion and reception of the Gentiles into his church.

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The design of the Jewish baptism, if baptism be practised by them, is supposed to be, to import a regeneration, whereby the proselyte is rendered a new man, and of a slave becomes free. The effect of it is, to cancel all former relations; so that those who were before akin to the person, after the ceremony ceased to be so. It is to this ceremony Christ is supposed to have alluded, in his expression to Nicodemus, that it was necessary he should be born again, in order to become his disciple.—The necessity of baptism to salvation, is grounded on those two sayings of our Saviour: *He that believeth, and is baptized, shall be saved;* and, *Except a man be born of water and of the Spirit, he cannot enter into the kingdom of God.*—The ancients did not generally think the mere want of baptism, where the procuring it was impracticable, excluded men absolutely from the hopes of eternal salvation. Some few of them, indeed, are pretty severe upon infants dying without baptism; and some others seem also, in general terms, to deny eternal life to adult persons dying without it: but when they interpret themselves, and speak more distinctly, they make some allowances, and except several cases, in which the want of baptism may be supplied by other means. Such are martyrdom, which commonly goes by the name of *second baptism in mens own blood*, in the writings of the ancients; because of the power and efficacy it was thought to have, to save men by the invisible baptism of the Spirit, without the external element of water. Faith, and repentance, were also esteemed a supplement to the want of baptism, in such catechumens as died while they were piously preparing themselves for baptism. Constantly communicating with the church, was thought to supply the want of baptism, in persons who had been admitted to communion, on a presumption of their being duly baptized, though the contrary afterwards appeared. For infants dying without baptism, the case was thought more dangerous; as here, no personal faith, repentance, or the like, could be pleaded, to supply the defect, and wash away original sin: on this account, they who spoke most favourably of them, as Greg. Nazianzen, and Severus bishop of Antioch, only assigned them a middle state, neither in heaven nor hell. But the Latins, as St Augustin, Fulgentius, Marius Mercator, &c. who never received the opinion of a middle state, concluded, as they could not be received into heaven, they must go to hell. Pelagius, and his followers, who denied original sin, asserted, that they might be admitted to eternal life and salvation, though not to the kingdom of heaven; between which they distinguished. Where the fault was not on the side of the child, nor his parents, but of the minister, or where any unavoidable accident rendered baptism absolutely impossible, Hincmar, and others, make an exception, in holding the child saved without baptism.

Opinions concerning the necessity of baptism to salvation.

Of the time place, and subjects of baptism.

The receiving baptism is not limited to any time, or age of life. Some contended for its being administered like circumcision, precisely on the eighth day, as Greg. Nazianzen; and others would have it deferred till the child is three years of age, and able to hear the mystic words, and make answer thereto, though they do not understand them. In the canon law we find divers injunctions against deferring the baptism of infants beyond the 37th day, 30th day, and the 9th day; some of them under pecuniary forfeitures.

Salmasius, and Suicerus from him, deliver it as authentic history, that for the two first ages, no one received baptism, who was not first instructed in the faith and doctrine of Christ, so as to be able to answer for himself, that he believed; because of those words, *He that believeth, and is baptized:* which, in effect, is to say, that no infant, for the first two ages, was ever admitted to Christian baptism. But, afterwards, they own, that pædo-baptism came in, upon the opinion that baptism was necessary to salvation. But Vossius, Dr Forbes, Dr Hammond, Mr Walker, and especially Mr Wall, who has exactly considered the testimony and authority of almost every ancient writer that has said any thing upon this subject, endeavour to evince, that infants were baptised even in the apostolical age. It is certain, Tertullian pleads strongly against giving baptism to infants; which shows, at least, that there was some such practice in his age, though he disapproved of it. It is certain, the ordinary subjects of this sacrament in the first ages were converts from Judaism and Gentilism, who, before they could be admitted to baptism, were obliged to spend some time in the state of catechumens, to qualify them to make their professions of faith, and a Christian life, in their own persons: for, without such personal professions, there were ordinarily no admission of them to the privilege of baptism.—Those baptised in their sick-beds were called *clinici;* and were held in some reproach, as not being reputed true Christians. Hence several censures, in councils and ecclesiastical writers, of clinic baptism. This clinic baptism was not sufficient to qualify the person, in case of recovery, for ordination. Some had their baptism put off by way of punishment, when they fell into gross and scandalous crimes, which were to be expiated by a longer course of discipline and repentance. This was sometimes 5, 10, 20 years, or more; even all their lives, to the hour of death, when their crimes were very flagrant.

In the earliest ages of the church, there was no stated time or place for the reception of baptism. Afterwards, Easter, Whitsuntide, and Epiphany, became solemn seasons, out of which baptism was not administered, except in cases of necessity. The catechumens, who were to receive it at these times, were called *competentes:* and to these it is that St Cyril addresses his catecheses. In the apostolical age, and some time after, before churches and baptisteries were generally erected, they baptized in any place where they had convenience; as John baptized in Jordan, and Philip baptized the eunuch in the wilderness, and Paul the jailor in his own house. But in after ages, baptisteries were built adjoining to the church; and then rules were made, that baptism should ordinarily be administered no where but in these buildings. Justinian, in one of his novels, refers to ancient laws, appointing that none of the sacred mysteries of the church should be celebrated in private houses. Men might have private oratories for prayer in their own houses; but they were not to administer baptism or the eucharist in them, unless by a particular licence from the bishop of the place. Such baptisms are frequently condemned in the ancient councils, under the name παραβαπτισματα, *baptisms in private conventicles.*

Ancient ceremonies.

As to the attendant ceremonies and manner of baptism in the ancient church: The person to be baptised, if

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if an adult, was first examined by the bishop or officiating priest, who put some questions to him; as, first, Whether he abjured the devil and all his works; secondly, Whether he gave a firm assent to all the articles of the Christian faith: to both which he answered in the affirmative. If the person to be baptized was an infant, these interrogatories were answered by his *sponsores*, or godfathers. Whether the use of sponsors was as old as the apostles days, is uncertain: perhaps it was not, since Justin Martyr, speaking of the method and form of baptism, says not a word of them.—After the questions and answers, followed exorcism; the manner and end of which was this; The minister laid his hands on the person's head, and breathed in his face, implying thereby the driving away or expelling of the devil from him, and preparing him for baptism, by which the good and holy spirit was to be conferred upon him.—After exorcism, followed baptism itself: and first the minister, by prayer, consecrated the water for that use. Tertullian says, "any waters may be "applied to that use; but then God must be first invocated; and then the Holy Ghost presently comes "down from heaven, and moves upon them, and sanctifies them." The water being consecrated, the person was baptized "in the name of the Father, and of "the Son, and of the Holy Ghost;" by which, "dedication of him to the blessed Trinity, the person "(says Clemens Alexandrinus) is delivered from the "corrupt trinity, the devil, the world, and the flesh." In performing the ceremony of baptism, the usual custom (except in clinical cases, or where there was scarcity of water), was to immerse and dip the whole body. Thus St Barnabas describing a baptized person, says, "We go down into the water full of sin "and filth, but we ascend bearing fruit in our hearts." And this practise of immersing the whole body was so general, that we find no exceptions made in respect either to the tenderness of infants, or the bashfulness of the other sex, unless in case of sickness or other disability. But to prevent any indecency, men and women were baptized apart. To which end, either the baptisteries were divided into two apartments, one for the men, the other for the women, as Bingham has observed; or the men were baptized at one time, and the women at another, as is shown by Vossius, from the *Ordo Romanus*, Gregory's *Sacramentarium*, &c. Add, that there was anciently an order of deaconesses, one part of whose business was to assist at the baptism of women. These precautions, however, rather indicate a scrupulous attention to delicacy, than imply any indecency in the circumstance of immersion itself. From the candidates being immersed, there is at least no reason to infer that they were naked: The present Baptists never baptise naked, though they always immerse. After immersion, followed the unction; by which (says St Cyril) was signified, that they were now cut off from the wild olive, and were ingrafted into Christ, the true olive tree; or else to show, that they were now to be champions for the gospel, and were anointed thereto, as the old athletæ were against their solemn games. With this anointing was joined the sign of the cross, made upon the forehead of the person baptized; which being done, he had a white garment given him, to denote his being washed from the defilements of sin, or in allusion to that of the apostle, "as many as are "baptized into Christ have put on Christ." From this custom the feast of Pentecost, which was one of the annual seasons of baptism, came to be called *Whitsunday*, i. e. *White-sunday*. This garment was afterwards laid up in the church, that it might be an evidence against such persons as violated or denied that faith which they had owned in baptism.—When the baptism was performed, the person baptized, according to Justin Martyr, "was received into the number of the faith"ful, who then sent up their public prayers to God, "for all men, for themselves, and for those who had "been baptized."

The ordinary ministers, who had the right of administering this sacrament, that is, of applying the water to the body, and pronouncing the formula, were presbyters or bishops; though on extraordinary occasions, laymen were admitted to perform the same.

Modern Forms. In the Church of Rome.

As to the present form of administering baptism, the church of Rome uses the following. When a child is to be baptised, the persons who bring it wait for the priest at the door of the church, who comes thither in his surplice and purple stole, attended by his clerks. He begins with questioning the godfathers, whither they promise, in the child's name, to live and die in the true catholic and apostolic faith, and what name they would give the child. Then follows an exhortation to the sponsors; after which the priest, calling the child by its name, asks it as follows: *What dost thou demand of the church?* The godfather answers, *Eternal life*. The priest goes on: *If you are desirous of obtaining eternal life, keep God's commandments, thou shalt love the Lord thy God*, &c. After which he breathes three times into the child's face, saying, *Come out of this child, thou evil spirit, and make room for the Holy Ghost*. This said he makes the sign of the cross on the child's forehead and breast, saying, *Receive the sign of the cross on thy forehead, and in thy heart*. Then taking off his cap, he repeats a short prayer; and laying his hand gently on the child's head, repeats a second prayer: which ended, he blesses some salt; and putting a little of it into the child's mouth, pronounces these words, *Receive the salt of wisdom*. All this is performed at the church-door. The priest, with the godfathers and godmothers, coming into the church, and advancing towards the font, repeat the apostle's creed and the Lord's-prayer. Being come to the font, the priest exorcises the evil spirit again; and taking a little of his own spittle, with the thumb of his right-hand, rubs it on the childs ears and nostrils, repeating, as he touches the right ear, the same word (*Ephatha, be thou opened*) which our Saviour made use of to the man born deaf and dumb. Lastly, they pull off its swaddling-cloaths, or strip it below the shoulders, during which the priest prepares the oils, &c. The sponsors then hold the child directly over the font, observing to turn it due east and west; whereupon the priest asks the child, *Whether he renounces the devil and all his works;* and the godfather having answered in the affirmative, the priest anoints the child between the shoulders in the form of a cross. Then taking some of the consecrated water, he pours part of it thrice on the child's head, at each perfusion calling on one of the Persons of the Holy Trinity. The priest concludes the ceremony of baptism with an exhortation.—The Romish church allows midwives, in cases of danger to baptize a child before it is come entirely out of its mother's womb: where it is to be observed, that some part of the body of

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of the child must appear before it can be baptized, and that it is baptized on the part which first appears: if it be the head, it is not necessary to rebaptize the child; but if only a foot or hand appears, it is necessary to repeat baptism. A still-born child, thus baptized, may be buried in consecrated ground.

In the Greek church.

The Greek church differs from the Romish, as to the rite of baptism, chiefly, in performing it by immersion, or plunging the infant all over in the water.

English form in the liturgy of K. Edward.

The forms of administrating baptism among us being too well known to require a particular description, we shall only mention one or two of the more material differences between the form, as it stood in the first liturgy of King Edward, and that in the English Common-Prayer book at present. First, the form of consecrating the water did not make a part of the office, in King Edward's liturgy, as it does in the present, because the water in the font was changed, and consecrated, but once a month. The form likewise itself was something different from that now used; and was introduced with a short prayer, that *Jesus Christ, upon whom (when he was baptized) the Holy Ghost came down in the likeness of a dove, would send down the same Holy Spirit, to sanctify the fountain of baptism*; which prayer was afterwards left out, at the second review.—By King Edward's first book, the minister is to dip the child in the water thrice; first, dipping the right-side; secondly, the left; the third time dipping the face toward the font. This trine immersion was a very ancient practice in the Christian church, and used in honour of the Holy Trinity; though some later writers say, it was done to represent the death, burial, and resurrection, of Christ, together with his three days continuance in the grave. Afterwards, the Arians making an ill use of it, by persuading the people that it was used to denote, that the three Persons in the Trinity were three distinct substances, the orthodox left it off, and used one single immersion.

By the first common-prayer of King Edward, after the child was baptized, the godfathers and godmothers were to lay their hands upon it, and the minister was to put on him the white vestment commonly called the *chrysome*, and to say, "Take this white vesture, as a token of the innocency, which, by God's grace, in this holy sacrament of baptism, is given unto thee; and for a sign, whereby thou art admonished, so long as thou livest, to give thyself to innocence of living, that after this transitory life thou mayest be partaker of the life everlasting. Amen." As soon as he had pronounced these words, he was to anoint the infant on the head, saying, "Almighty God, the Father of our Lord Jesus Christ, who hath regenerated thee by water and the Holy Ghost, and hath given unto thee remission of all thy sins; may he vouchsafe to anoint thee with the unction of his Holy Spirit, and bring thee to the inheritance of everlasting life. Amen." This was manifestly done in imitation of the practice of the primitive church.

The custom of sprinkling children, instead of dipping them in the font, which at first was allowed in case of the weakness or sickness of the infant, has so far prevailed, that immersion is at length quite excluded. What principally tended to confirm the practice of affusion or sprinkling, was, that several of our Protestant divines, flying into Germany and Switzerland during the bloody reign of queen Mary, and returning home when queen Elizabeth came to the crown, brought back with them a great zeal for the Protestant churches beyond sea, where they had been sheltered and received; and having observed, that at Geneva and some other places, baptism was administered by sprinkling, they thought they could not do the church of England a greater piece of service than by introducing a practice dictated by so great an oracle as Calvin. This, together with the coldness of our northern climate, was what contributed to banish entirely the practice of dipping infants in the font.

Notions concerning the effects of baptism.

Many different notions have been entertained concerning the effects of baptism, which it would be endless to enumerate.—The Remonstrants and Socinians reduce baptism to a mere sign of divine grace. The Romanists, on the contrary, exalt its power; holding that all sin is entirely taken away by it; that it absolutely confers the grace of justification, and consequently grace *ex opere operato*. Some also speak of an indelible character impressed on the soul by it, called *character dominicas* and *character regius*: but this is held, by others, a mere chimera; for that the spiritual character, conferred in regeneration, may easily be effaced by mortal sins. Dodwell maintained, that it is by baptism the soul is made immortal; so that those who die without it will not rise again. It must be added, he restrains this effect to episcopal baptism alone. From the effects ordinarily ascribed to baptism, even by ancient writers, it should seem, that the ceremony is as much of heathen as of Jewish origin; since Christians do not restrain the use of it, like the Jews, to the admission of new members into the church, but hold, with the heathens, a virtue in it for the remitting and washing away sins. The Bramins are still said to baptize with this latter view, at certain seasons, in the river Ganges; to the waters whereof they have annexed a cleansing or sanctifying quality; and hence it is that they flock from all parts, even of Tartary, driven by the expectation of their being eased of their load of sins. But, in this point, many Christians seem to have gone beyond the folly of the heathens. It was only the smaller sins of infirmity which these latter held to be expiable by washing; for crimes of a blacker dye, they allowed no water could efface them, no purgation could discharge them. The Christian doctrine of a total remission of sins by baptism could not fail, therefore, to scandalize many among the heathens, and furnished Julian an occasion of satirising Christianity itself: "Whoever (says he) is guilty of rapes, murder, sacrilege, or any abominable crime, let him be washed with water, and he will become pure and holy."

In the ancient church, baptism was frequently conferred on Jews by violence; but the church itself never seems to have allowed of force on this occasion. By a canon of the fourth council of Toledo, it is expressly forbid to baptize any against their wills. That which looks most like force in this case, allowed by law, were two orders of Justinian; one of which appoints the heathens, and the other Samaritans to be baptized, with their wives and children and servants, under pain of confiscation. By the ancient laws, baptism was not to be conferred on image-makers, stage-players, gladiators, *aurigæ* or public drivers, magicians,

cians, or even strolling beggars, till they quitted such professions. Slaves were not allowed the privilege of baptism without the testimony and consent of their masters; excepting the slaves of Jews, Heathens, and heretics, who were not only admitted to baptism, but, in consequence thereof had their freedom. Vossius has a learned and elaborate work *De Baptismo*, wherein he accurately discusses all the questions concerning baptism according to the doctrines of the ancients.

Bingham Orig. Eccl. l. 11. c. 5. §. 4. l. 8. c. 11. §. 17.

Baptism by Fire, spoken of by St John the Baptist, has occasioned much conjecture. The generality of the fathers held, that believers, before they enter paradise, are to pass through a certain fire, which is to purify them from all pollutions remaining on them unexpiated. Others, with St Basil, understand it of the fire of hell; others, of that of tribulation and temptation. Others, with St Chrysostom, will have it denote an abundance of graces. Others suppose it to mean the descent of the Holy Ghost on the apostles, in form of fiery tongues. Lastly, others maintain, that the word *fire* here is an interpolation: and that we are only to read the text, *He that shall come after me will baptize you with the Holy Ghost*. In reality it is not found in divers manuscript copies of St. Matthew.

The ancient Seleucians and Hermians, understanding the passage literally, maintained, that material fire was necessary in the administration of baptism. But we do not find how, or to what part of the body they applied it, or whether they were satisfied with obliging the person baptized to pass through the fire. Valentinus rebaptized all who had received water-baptism, and conferred on them the baptism of fire.

Bis docuit tingi, traductoque corpore flamma.
TERTULL. Carm. contr. Marc. l. 1.

Heracleon, cited by Clemens Alexandrinus, says, that some applied a red-hot iron to the ears of the person baptized, as if to impress some mark upon him.

Baptism of the Dead, a custom which anciently prevailed among some people in Africa, of giving baptism to the dead. The third council of Carthage speaks of it as a thing that ignorant Christians were fond of. Gregory Nazianzen also takes notice of the same superstitious opinion prevailing among some who delayed to be baptized. In his address to this kind of men, he asks, whether they staid to be baptized after death? Philastrius also notes it as the general error of the Montanists or Cataphrygians, that they baptized men after death. The practice seems to be grounded on a vain opinion, that, when men had neglected to receive baptism in their life-time, some compensation might be made for this default by receiving it after death.

Baptism of the Dead, was also a sort of vicarious baptism, formely in use, where a person dying without baptism, another was baptized in his stead.

St Chrysostom tells us, this was practised among the Marcionites with a great deal of ridiculous ceremony; which he thus describes: After any catechumen was dead, they hid a living man under the bed of the deceased; then coming to the dead man, they asked him, whether he would receive baptism? and he making no answer, the other answered for him, and said, he would be baptized in his stead: and so they baptized the living for the dead.

Epiphanius assures us, the like was also practised among the Corinthians. This practice they pretended to found on the Apostle's authority; alledging that text of St. Paul for it, *If the dead rise not at all, what shall they do who are baptized for the dead?* A text which has given occasion to a great variety of different systems and explications. Bosius enumerates no less than nine different opinions among learned divines concerning the sense of the phrase *being baptized for the dead.*

St Ambrose and Walafred Strabo seem clearly of opinion, that the apostle had respect to such a custom then in being; and several moderns have given into the same opinion, as Baronius, Jos. Scaliger, Justellus, and Grotius.

Several among the Roman-catholics, as Bellarmin, Salmeron Menochius, and a number of schoolmen, understand it of the baptism of tears, and penance, and prayers, which the living undergo for the dead; and thus alledge it as a proof of the belief of purgatory in St Paul's days.

Hypothetical Baptism, that formerly administered in certain doubtful cases, with this formula: *If thou art baptized, I do not rebaptize; if thou art not, I baptize thee in the name of the Father*, &c. This sort of baptism, enjoined by some ancient constitutions of the English church, is now fallen into disuse.

Solemn Baptism, that conferred at stated seasons; such, in the ancient church, were the *Paschal baptism*, and that at Whitsuntide. This is sometimes also called *general baptism*.

Lay-Baptism, we find to have been permitted by both the Common-prayer Books of King Edward and that of Queen Elizabeth, when an infant is in immediate danger of death, and a lawful minister cannot be had. This was founded upon the mistaken notion of the impossibility of salvation without the sacrament of baptism: but afterwards, when they came to have clearer notions of the sacraments, it was unanimously resolved in a convocation, held in the year 1575, that even private baptism, in a case of necessity was only to be administered by a lawful minister.

BAPTISM is also applied, abusively, to certain ceremonies used in giving names to things inanimate.

The ancients knew nothing of the custom of giving baptism to inanimate things, as bells, ships, and the like, by a superstitious consecration of them. The first notice we have of this is in the Capitulars of Charles the Great, where it is only mentioned to be censured; but, afterwards, it crept into the Roman offices by degrees. Baronius carries its antiquity no higher than the year 968, when the greatest bell of the church of Lateran was christened by Pope John III. At last it grew to that superstitious height, as to be thought proper to be complained of in the *Centum Gravamina* of the German nation, drawn up in the public diet of the empire held at Nuremberg *anno* 1581; where (after having described the ceremony of baptizing a bell, with godfathers, who make responses as in baptism, and give it a name, and clothe it with a new garment as Christians were used to be clothed, and all this to make it capable of driving away tempests and devils), they conclude against it, not only a superstitious practice, but contrary to the Christian religion, and a mere seduction of the simple people.

BAPTISM, in the sea language, a ceremony in long voyages on board merchant ships, practised both on persons

persons and vessels who pass the tropic or line for the first time. The baptizing the vessel is simple, and consists only in washing them throughout with sea-water; that of the passengers is more mysterious The oldest of the crew, that has past the tropic or line, comes with his face blacked, a grotesque cap on his head, and some sea-book in his hand, followed by the rest of the seamen dressed like himself, each having some kitchen utensil in his hand, with drums beating; he places himself on a seat on the deck, at the foot of the main mast. At the tribunal of this mock magistrate, each passenger not yet initiated, swears he will take care the same ceremony be observed, whenever he is in the like circumstances: Then, by giving a little money by way of gratification, he is discharged with a little sprinkling of water; otherwise he is heartily drenched with streams of water poured upon him; and the ship-boys are inclosed in a cage, and ducked at discretion.—The seamen, on the baptizing a ship, pretend to a right of cutting off the beak-head, unless redeemed by the captain.

BAPTISMAL, something belonging to baptism; thus we say baptismal vow, presents, &c.

Baptismal Vow or *Covenant*, a profession of obedience to the laws of Christ, which persons in the ancient church made before baptism. It was an indispensable part of the obligation on catechumens, before they were admitted to the ceremony of regeneration. It was made by turning to the East; for what mystical reasons, is not well agreed on.

Baptismal Presents are in use in Germany, made by the sponsors to the infant, consisting of money, plate, or even sometimes fiefs of lands; which by the laws of the country are to be kept for the child till of age, the parents having only the trust, not the right, of disposing of them. An anonymous author has published a discourse express on this occasion, intitled *De pecunia lustrica*.

BAPTIST (John), Monnoyer, a painter of flowers and fruit, was born at Lisle in 1635, and educated at Antwerp, where he perfected himself in the knowledge of his art, and in his first years was intended for a painter of history: but having soon observed that his genius more strongly inclined him to the painting of flowers, he applied his talents to those subjects, and in that style became one of the greatest masters. His pictures are not so exquisitely finished as those of Van Huysum, but his composition and colouring are in a bolder style. His flowers have generally a remarkable freedom and looseness, as well in the disposition as in penciling; together with a tone of colouring that is lively, admirable, and nature itself. The disposition of his objects is surprisingly elegant and beautiful; and in that respect his compositions are easily known, and as easily distinguished from the performances of others. He died in 1699.—He left a son, Anthony, who painted flowers in the same style and manner, and had great merit.

BAPTISTS, in eccesiastical history, (from βαπτιζω, *I baptize*); a denomination of Christians, distinguished from other Christians by their particular opinions respecting the mode and the subjects of baptism.

Instead of administering the ordinance by sprinkling or pouring water, they maintain that it ought to be administered only by immersion. Such, they insist, is the meaning of the word βαπτιζω; so that a command to baptize is a command to immerse. Thus it was understood by those who first administered it. John the Baptist, and the apostles of Christ, administered it in Jordan and other rivers, and places where there was much water. Both the administrators and the subjects are described as going down into, and coming up again out of, the water; and the baptized are said to be buried in baptism, and to be raised again: which language could not, they say, be properly adopted on supposition of the ordinance being administered in any other manner than by immersion. Thus also they affirm it was in general administered in the primitive church. Thus it is now administered in the Russian and Greek church: and thus it is, at this day, directed to be administered in the church of England, to all who are thought capable of submitting to it in this manner. With regard to the subjects of baptism, the Baptists say, that this ordinance ought not to be administered to children or infants at all, nor to grown up persons in general, but to adults only of a certain character and description. Our Saviour's commission to his apostles, by which Christian baptism was instituted, is to go and teach all nations, baptizing them: that is, say they, not to baptize all they meet with; but first instruct them—to teach all nations, or to preach the gospel to every creature,—and whoever receives it, him to baptize in the name of the Father, and of the Son, and of the Holy Ghost. To such persons, and to such only, baptism appears to have been administered by the apostles, and the immediate disciples of Christ. They are described as repenting of their sins, as believing in Christ, and as having gladly received the word. Without these qualifications, Peter acquaints those who were converted by his sermon, that he could not have admitted them to baptism. Philip holds the same language in his discourse with the eunuch; and Paul treats Lydia, the jailor, and others, in the same manner. Without these qualifications, Christians in general think it wrong to admit persons to the Lord's supper; and, for the same reasons, without these qualifications, at least a profession of them, the Baptists think it wrong to admit any to baptism. Wherefore they with-hold it, not only from the impenitently vicious and profane, and from infidels who have no faith; but also from infants and children, who have no knowledge, and are incapable of every action civil and religious. They further insist, that all positive institutions depend entirely upon the will and declaration of the institutor; and therefore, that reasoning by analogy from abrogated Jewish rites is to be rejected, and the express commands of Christ respecting the mode and subjects of baptism ought to be our only rule.

The Baptists in England form one of the denominations of Protestant dissenters. They separate from the establishment for the same reasons as their brethren of the other denominations do; and from additional motives derived from their particular tenets respecting baptism. The constitution of their churches, and their modes of worship, are congregational or independent: in the exercise of which they are protected, in common with other dissenters, by the act of toleration. Before this act, they were liable to pains and penalties as nonconformists, and often for their peculiar senti-

ments

ments as Baptists. A proclamation was issued out against them, and some of them were burnt in Smithfield in 1538. They bore a considerable share in the persecutions of the last and of the preceding centuries; and, as it should seem, in those of some centuries before; for there were several among the Lollards and the followers of Wickliff, who disapproved of infant-baptism. There were many of this persuasion among the Protestants and reformers abroad. In Holland, Germany, and the North, they went by the names of ANABAPTISTS and MENNONITES: and, in Piedmont and the south, they were found among the ALBIGENSES and WALDENSES. See the histories of the Reformation, and the above articles in this Dictionary.

The *Baptists* subsist under two denominations, viz. the *Particular* or Calvinistical, and the *General* or Arminian. The former is by far the most numerous. Some of both denominations allow of *mixed communion*, viz. of persons who have been sprinkled in their infancy, and therefore unbaptized in the view of the Baptists; others disallow it: and some of them observe the seventh day of the week as the sabbath, apprehending the law that enjoined it, not to have been repealed by Christ or his apostles. But a difference of opinion respecting these and other matters, is not peculiar to the Baptists: it is common to all Christians, and to all bodies of men who think and judge for themselves.

BAPTISTERY, in ecclesiastical writers, a place in which the ceremony of baptism is performed.

In the ancient church it was one of the exedræ or buildings distinct from the church itself: and consisted of a porch or anti-room where the persons to be baptized made their confession of faith, and an inner room where the ceremony of baptism was performed. Thus it continued till the sixth century, when the baptisteries began to be taken into the church-porch, and afterwards into the church itself.

The ancient baptisteries were commonly called φωτιστηρια, *photisteria*, q. d. places of illumination; an appellation sometimes given to baptism. Or they might have the name for another reason, because they were the places of an illumination, or instruction, preceding baptism: for here the catechumens seem to have been trained up, and instructed in the first rudiments of the Christian faith.

Those baptisteries were anciently very capacious; because, as Dr Cave observes, the stated times of baptism returning but seldom, there were usually great multitudes to be baptized at the same time: and then the manner of baptizing, by immersion, or dipping under water, made it necessary to have a large font likewise. In *Venantius Fortunatus*, it is called *aula baptismatis*, the large hall of baptism; which was indeed so capacious, that we sometimes read of councils meeting and sitting therein. This hall, or chapel, was always kept shut during Lent, and the door sealed up with the bishop's seal, not to be opened till Maunday-Thursday.

The baptistery was always reputed a sacred place. In the Roman order, we find the ceremonies used in the consecration of the baptisteries: they were to be built of a round figure, and distinguished with the image of St John the Baptist; over the bason or font was a figure of a dove in gold or silver; to represent the Holy Ghost.

The name *baptistery* is sometimes also given to a kind of chapel in a large church, which served for the same office. It is an observation of some learned men, that anciently there was but one baptistery in a city, and that at the bishop's church; and that afterwards they were set up in parish churches, with the special allowance however of the bishop.

BAR, in a general sense, denotes a slender piece of wood or iron, for keeping things close together.

BAR, in courts of justice, an inclosure made with a strong partition of timber, where the council are placed to plead causes. It is also applied to the benches where the lawyers or advocates are seated, because anciently there was a bar to separate the pleaders from the attorneys and others. Hence lawyers who are called to the bar, or licensed to plead, are termed *barristers*, an appellation equivalent to *licentiate* in other countries.

BAR, or *Barr*, (Latin *barra*, and in French *barre*), in a legal sense, is a plea or peremptory exception of a defendant, sufficient to destroy the plaintiff's action. And it is divided into bar to common intendment, and bar special; bar temporary, and perpetual. Bar to a common intendment is an ordinary or general bar, which usually disableth the declaration of the plaintiff; bar special is that which is more than ordinary, and falls out upon some special circumstance of the fact as to the case in hand. Bar temporary is such a bar as is good for the present, but may afterwards fail; and bar perpetual is that which overthrows the action of the plaintiff for ever.

BAR, in heraldry, an ordinary in form of the fess, but much less. See HERALDRY.

BAR, in the menage, the highest part of that place of a horse's mouth situated between the grinders and tushes, so that the part of the mouth which lies under and at the side of the bars retains the name of the gum. A horse with sensible bars has a fine light mouth, with an even and firm appui. See APPUI.

To BAR *a Vein*, in farriery, is an operation performed upon the veins of the legs of a horse and other parts, with intent to stop the malignant humours. It is done by opening the skin above it, disengaging it, and tying it both above and below, and striking between the two ligatures.

BAR, in music, a stroke drawn perpendicularly across the lines of a piece of music, including between each two a certain quantity or measure of time, which is various as the time of the music is either triple or common. In common time, between each two bars is included the measure of four crotchets; in triple, three. The principal use of bars is to regulate the beating of time in a concert. The use of bars is not to be traced higher than the time when the English translation of Adrian le Roy's book on the Tablature was published, *viz.* the year 1574; and it was sometime after that before the use of bars became general. To come nearer to the point, Barnard's cathedral music, printed in 1641, is without bars: but bars are to be found throughout in the *Ayres and Dialogues* of Henry Lawes published in 1653; from whence it may be conjectured that we owe to Lawes this improvement.

BAR, in hydrography, denotes a bank of ſand, or other matter, whereby the mouth of a river is in a manner choaked up.

The term *bar* is alſo uſed for a ſtrong beam wherewith the entrance of a harbour is ſecured: This is more commonly called *boom.*

BAR of a tavern or coffee-houſe, the place where the waiters attend to anſwer the calls of the cuſtomers.

BAR, among printers, denotes a piece of iron with a wooden handle, whereby the ſcrew of the preſs is turned in printing. See PRINTING.

BARS of Iron, are made of the metal of the ſows and pigs as they come from the furnace. Theſe paſs thro' two forges called the *finery* and the *chauſery*; where, undergoing five ſeveral heats, they are formed into bars.

BAR, a very ſtrong city of Podolia in Poland, upon the river Kiow. E. Long. 28. 30. N. Lat. 50. 6.

BAR, a duchy of France, bounded on the eaſt by Lorrain, on the north by Luxembourg, on the weſt by Champagne, on the ſouth by part of the ſame country and by Franche Compte. It is croſſed by the river Meuſe from north to ſouth, and watered by ſeveral other rivers, which render it very fertile. It is divided into four balliages, *viz.* Baſſilyni, Bar, St Michael, and Clermont. The chief towns are Bar-le-duc, Clermont, St Michael, Longuey, Pont a Mouſſon, and Stenay. In 1736, it was given to Staniſlaus then king of Poland.

BAR-le-Duc, the capital of the duchy of Bar, ſeated on the declivity of a hill. It is divided into the higher and lower town: the lower is watered by the rivulet Orney, which abounds with excellent trouts. The wines are excellent, and not inferior to thoſe of Champagne. E. Long. 5. 30. N. Lat. 48. 35.

BAR-le-Mont, a town of the French Netherlands, in Hainault, ſituated on the river Sombre. E. Long. 3. 40. N. Lat. 50. 10.

BAR ſur Auche, an ancient town of France, ſeated at the foot of a mountain. E. Long. 4. 50. N. Lat. 48. 14.

BAR ſur Seine, a town of France, in the duchy of Burgundy, ſeated between a mountain which covers it on the weſt, and the river Seine which runs on the eaſt. E. Long. 4. 30. N. Lat. 48. 5.

BAR-Maſter, among miners, the perſon who keeps the gage, or diſh, for meaſuring the ore.

BARA (anc. geog.), a ſmall iſland in the Adriatic, oppoſite to Brunduſium: the *Pharos* of Mela. Alſo a frith, or arm of the ſea of Britannia Secunda (Ptolemy); ſuppoſed to be the Murray-frith.

BARA, one of the Hebrides or Weſtern Iſlands of Scotland. It is a ſmall rock, only a quarter of a mile in circumference, being part of a chain called the *Long Iſland*, the whole cluſter appearing at low water as one iſland. Bara is altogether barren; but abounds with great numbers of ſea-fowl, ſuch as ſolon geeſe, guillamotes, puffins, &c.

BARA, the name of a feſtival celebrated with much magnificence at Meſſina, and repreſenting the aſſumption of the Virgin. The *bara*, though uſed as the general denomination of this feſtival, ſignifies more particularly a vaſt machine 50 feet high, at the top of which a young girl of 14, repreſenting the Virgin, ſtands upon the hand of an image of Jeſus Chriſt. Round him turn vertically, in a circle, 12 little children which repreſent the ſeraphims; below them, in another circle, which turns horizontally, are 12 more repreſenting the cherubims: below theſe a ſun turns vertically, with a child at the extremity of each of the four principal *radii* of his circle, who aſcend and deſcend with his rotation, yet ſtill ſtand upright. Below the ſun is the loweſt circle, about ſeven feet from the ground, in which 12 boys turn horizontally without interruption: theſe are intended for the twelve apoſtles, who are ſuppoſed to ſurround the tomb of the Virgin at the moment when ſhe aſcends into heaven. This complication of ſuperſtitious whirligigs may have already nearly turned the ſtomachs of ſome of our readers, or at leaſt rendered them ſqueamiſh. But think of the poor little cherubims, ſeraphims, and apoſtles, who are twirled about in this proceſſion! for, ſays Mr Houel, "ſome of them fall aſleep, many of them vomit, and ſeveral do ſtill worſe:" but theſe unſeemly effuſions are no drawback upon the edification of the people; and nothing is more common than to ſee fathers and mothers ſoliciting with ardour for their boys and girls the pious diſtinction of puking at the bara. This machine is not drawn by aſſes or mules, but by a multitude of robuſt monks.

Houel's Deſcriptive Travels thro' Sicily, &c.

BARABINZIANS, a tribe of Tartars, living on both ſides the river Iris. They ſeem to derive their name from the *Barabaian* deſart, whoſe lakes ſupply them abundantly with fiſh, on which and their cattle they chiefly ſubſiſt. They have plenty of game and wild-fowl of every kind, particularly ducks and puffins. Moſt of them are heathens, but Mahometaniſm daily gains ground among them. Some of them pay tribute to the Empreſs of Ruſſia, and others to the Khan Taiſha.

BARACOA, a town in the north eaſt part of the iſland of Cuba. W. Long. 76. 10. N. Lat. 21. 5.

BARALIPTON, among logicians, a term denoting the firſt indirect mode of the firſt figure of ſyllogiſm. A ſyllogiſm in baralipton, is when the two firſt propoſitions are general, and the third particular, the middle term being the ſubject in the firſt propoſition, and the predicate in the ſecond. The following is of this kind:

BA. Every evil ought to be feared;
RA. Every violent paſſion is an evil;
LIP. Therefore ſomething that ought to be feared is a violent paſſion.

BARALLOTS, in church-hiſtory, a ſect of heretics at Bologna in Italy, who had all things in common, even their wives and children.—Their facility in complying with all manner of debauchery made them get the name *obedientes*, "compliers."

BARANCA DE MALAMBO, a town of Terra Firma in America, with a biſhop's ſee and a good haven. It is a place of great trade, and is ſeated on the river Magdaleine. W. Long. 75. 30. N. Lat. 11. 10.

BARANGI, officers among the Greeks of the lower empire. Cujas calls them Latin *protectores*, and others give them the name of *ſecurigeri*. It was their buſineſs to keep the keys of the city gates, where the emperor reſided.

BARANWAHR, a town of Lower Hungary, in a county of the ſame name, taken by the emperor of Germany from the Turks in 1684. It is ſeated between

tween Buda and Belgrade, in E. Long. 20. 5. N. Lat. 46. 0.

BARATHRUM, in antiquity, a deep dark pit at Athens, into which condemned perſons were caſt headlong. It had ſharp ſpikes at the top, that no man might eſcape out; and others at the bottom, to pierce and torment ſuch as were caſt in.—Its depth and capaciouſneſs made it to be applied proverbially to a covetous perſon: to a glutton, called *Barathro* by the Romans (Lucretius, Horace), and *Barathrum* in the ſame ſenſe (Horace); and for a common proſtitute (Platus).

BARATIERE (Philip), a moſt extraordinary inſtance of the early and rapid exertion of mental faculties. This ſurpriſing genius was the ſon of Francis Baratiere, miniſter of the French church at Schwobach near Nuremberg, where he was born Jan. 10th 1721. The French was his mother-tongue, together with ſome words of High Dutch; but by means of his father inſenſibly talking Latin to him, it became as familiar to him as the reſt: ſo that, without knowing the rules of grammar, he at four years of age talked French to his mother, Latin to his father, High Dutch to the maid or neighbouring children; and all this without mixing or confounding the reſpective languages. About the middle of his fifth year he acquired Greek in like manner; ſo that in 15 months he perfectly underſtood all the Greek books in the Old and New Teſtament, which he readily tranſlated into Latin. When he was five years and eight months old, he entered upon Hebrew; and in three years time was ſo expert in the Hebrew text, that from a bible without points, he could give the ſenſe of the original in Latin or French; or tranſlate extempore the Latin or French verſions into Hebrew, almoſt word for word; and had all the Hebrew pſalms by heart. He compoſed at this time a dictionary of rare and difficult Hebrew words, with critical remarks and philological obſervations, in about 400 pages in 4to; and, about his tenth year, amuſed himſelf for twelve months with the Rabinical writers. With theſe he intermixed a knowledge of the Chaldaic, Syriac, and Arabic; and acquired a taſte for divinity and ecceſiaſtical antiquity, by ſtudying the Greek fathers, and councils of the firſt four ages of the church. In the midſt of theſe occupations, a pair of globes coming into his poſſeſſion, he could in 8 or 10 days time reſolve all the problems on them; and in about three months, in Jan. 1735, deviſed his project for the diſcovery of the longitude, which he communicated to the Royal Society at London and the Royal Academy of Sciences at Berlin. In June 1731, he was matriculated in the univerſity of Altorf; and at the cloſe of the year 1732, he was preſented by his father at the meeting of the reformed churches of the circle of Franconia; who, aſtoniſhed at his wonderful talents, admitted him to aſſiſt in the deliberations of the ſynod; and to preſerve the memory of ſo ſingular an event, it was ordered to be regiſtered in their acts. In 1734, the Margrave of Brandenburgh Anſpach granted this young ſcholar the uſe of whatever books he wanted from the Anſpach library, together with a penſion of 50 florins, which he enjoyed three years; and his father receiving a call to the French church at Stetin in Pomerania, young Baratiere was, on the journey, admitted maſter of arts, with univerſal applauſe, at the univerſity of Hall: at Berlin he was honoured with ſeveral converſations with the king of Pruſſia, and was received into the royal academy. Towards the cloſe of his life he acquired a taſte for medals, inſcriptions, and antiquities; metaphyſical inquiries, and experimental philoſophy, intervening occaſionally between theſe ſtudies. He wrote ſeveral eſſays and diſſertations; made aſtronomical remarks, and laborious calculations; took great pains towards a hiſtory of the hereſies of the anti-trinitarians, and of the 30 years war in Germany: his laſt publication, which appeared in 1740, was on the ſucceſſion of the biſhops of Rome. The final work he engaged in, and for which he had gathered large materials, was *Inquiries concerning the Egyptian Antiquities*. But the ſubſtance of this blazing meteor was now almoſt exhauſted: he was always weak and ſickly; and died October 5. 1740, aged 19. years 8 months and 16 days. He publiſhed 11 different pieces, and left 26 manuſcripts on various ſubjects, the contents of which may be ſeen in his life written by M. Formey profeſſor of philoſophy at Berlin.

BARATZ (Turkiſh), letters-patent granted by the Turkiſh emperors to the Greek patriarch, biſhops, &c. for the exerciſe of their eccleſiaſtical functions. This *Baratz* gives the biſhops full power and authority to eſtabliſh and depoſe the inferior clergy, and all other religious perſons; to grant licences for marriages, and iſſue out divorces; to collect the revenues belonging to the churches; to receive the pious legacies bequeathed to them; in ſhort, to enjoy all the privileges and advantages belonging to their high ſtation: and all this (as it is expreſſed in the baratz itſelf), "according to the vain and idle ceremonies of the Chriſtians."

BARB, or BARBE, a horſe brought from Barbary. See EQUUS.

BARBA, in botany, a ſpecies of *pubes*, or down, with which the ſurface of ſome plants is covered. The term was invented by Linnæus; and by its application in the *Species Plantarum*, ſeems to ſignify a tuft or bunch of ſtrong hairs terminating the leaves. *Meſembryanthemum barbatum*, furniſhes an example.

The word is alſo often uſed in compoſition with ſome other, to form the trival names of ſeveral plants, as *barba jovis*, *barba capræ*, &c.

BARBACAN, or BARBICAN, an outer defence or fortification to a city or caſtle, uſed eſpecially as a fence to the city or walls; alſo, an aperture made in the wall of a fortreſs, to fire through upon the enemy. See CASTLE.

BARBACAN is alſo uſed to denote a fort at the entrance of a bridge, or the outlet of a city, having a double wall with towers.

BARBADOES, the moſt eaſterly of all the Caribbee Iſlands, ſubject to Great Britain, and, according to the beſt geographers, lying between 59. 50. and 60. 2. of weſt longitude, and between 12. 56. and 13. 16. of north latitude. Its extent is not certainly known: the moſt general opinion is, that it is 25 miles from north to ſouth, and 15 from eaſt to weſt; but theſe menſurations are ſubject to ſo many difficulties and uncertainties, that it will perhaps convey a more adequate idea of this iſland to tell the reader than in reality it does not contain above 107,000 acres. The climate is hot, but not unwholeſome, the heat being qualified by ſea-breezes; and a temperate regimen renders this iſland as ſafe to live in as any climate ſouth of Great Britain; and, according to the opinion of many, as even Great Britain itſelf. This iſland has on its eaſt ſide two ſtreams that are called *rivers*, and in the middle is ſaid to have a bituminous ſpring which ſends forth a liquor like tar, and ſerves for the ſame uſes as pitch or lamp-oil. The iſland abounds in wells of good water, and has ſeveral reſervoirs for rain-water. Some parts of the ſoil are ſaid to be hollowed into caves, ſome of them capable of containing 300 people. Theſe are imagined to have been the lurking-places of runaway negroes, but may as probably be natural excavations. The woods that formerly grew upon the iſland have been all cut down, and the ground converted into ſugar plantations. When thoſe plantations were firſt formed, the ſoil was prodigiouſly fertile, but has ſince been worn out, inſomuch, that about the year 1730, the planters were obliged to raiſe cattle for the ſake of their dung, by which means the profit of their plantations was reduced to leſs than a tenth of its uſual value. Notwithſtanding the ſmallneſs of Barbadoes, its ſoil is different; being in ſome places ſandy and light, in others rich, and in others ſpongy; but all of it is cultivated according to its proper nature, ſo that the iſland preſents to the eye the moſt beautiful appearance that can be imigined. Oranges and lemons grow in Barbadoes in great plenty, and in their utmoſt perfection. The lemon juice here has a peculiar fragrancy. The citrons of Barbadoes afford the beſt drams and ſweetmeats of any in the world, the Barbadoes ladies excelling in the art of preſerving the rhind of the citron fruit. The juice of the limes, or dwarf lemons, is the moſt agreeable ſouring we know, and great quantities of it have of late been imported into Britain and Ireland. The pine apple is alſo a native of Barbadoes, and grows there to much greater perfection than it can be made to do in Europe by any artificial means. A vaſt number of different trees peculiar to the climate are alſo found to flouriſh in Barbadoes in great perfection; ſuch as the aloe, mangrove, calabaſh, cedar, cotton, maſtic, &c. Here likewiſe are produced ſome ſenſitive plants, with a good deal of garden ſtuff, which is common in other places. In ſhort, a native of the fineſt, the richeſt, and moſt diverſified country in Europe, can hardly form an idea of the variety of delicious and at the ſame time nutritive vegetable productions with which this iſland abounds.

When Barbadoes was firſt diſcovered by the Engliſh, few or no quadrupeds were found upon it, except hogs, which had been left there by the Portugueſe. For convenience of carriage to the ſea-ſide, ſome of the planters at firſt procured camels; which undoubtedly would in all reſpects have been preferable to horſes for their ſugar and other works; but the nature of the climate diſagreeing with that animal, it was found impoſſible to preſerve the breed. They then applied for horſes to Old and New England: from the former they had thoſe that were fit for ſhew and draughts; from the latter thoſe that were proper for mounting their militia, and for the ſaddle. They had likewiſe ſome of an inferior breed from Curaſſao, and other ſettlements. They are reported to have had their firſt breed of black cattle from Bonaviſta and the iſle of May; they now breed upon the iſland, and often do the work of horſes. Their aſſes are very ſerviceable in carrying burdens to and from the plantations. The hogs of Barbadoes are finer eating than thoſe of Britain, but the few ſheep they have are not near ſo good. They likewiſe have goats, which when young are excellent food. Racoons and monkies are alſo found here in great abundance. A variety of birds are produced on Barbadoes, of which the humming bird is the moſt remarkable. Wild fowl do not often frequent this iſland; but ſometimes teal are found near their ponds. A bird which they call the *man of war*, is ſaid to meet ſhips at 20 leagues from land, and their return is, to the inhabitants, a ſure ſign of the arrival of theſe ſhips. When the wind blows from the ſouth and ſouth-weſt, they have flocks of curlews, plovers, ſnipes, wild pigeons, and wild ducks. The wild pigeons are very fat and plentiful at ſuch ſeaſons, and rather lager than thoſe of England. The tame pigeons, pullets, ducks, and poultry of all kinds, that are bred at Barbadoes, have alſo a fine flavour, and are accounted more delicious than thoſe of Europe. Their rabbits are ſcarce; they have no hares; and if they have deer of any kind, they are kept as curioſities. The inſects of Barbadoes are not venomous, nor do either their ſnakes or ſcorpions ever ſting. The muſketoes are troubleſome, and bite; but are more tolerable in Barbadoes than on the continent. Various other inſects are found on the iſland, ſome of which are troubleſome, but in no greater degree than thoſe that are produced by every warm ſummer in England. Barbadoes is well ſupplied with fiſh; and ſome caught in the ſea ſurrounding it are almoſt peculiar to itſelf; ſuch as the parrot-fiſh, ſnappers, grey cavallos, terbums, and coney-fiſh. The mullets, lobſters, and crabs, caught here are excellent; and the green turtle is perhaps the greateſt delicacy that ancient or modern luxury can boaſt of. At Barbadoes this delicious ſhell-fiſh ſeldom ſells for leſs than a ſhilling a pound, and often for more. There is found in this iſland a kind of land crab which eats herbs wherever it can find them, and ſhelters itſelf in houſes and hollows of trees. According to report, they are a ſhell-fiſh of paſſage; for in March they travel to the ſea in great numbers. See CANCER.

The inhabitants may be reduced to three claſſes, viz. the maſters, the white ſervants, and the blacks. The former are either Engliſh, Scots, or Iriſh: but the great encouragement given by government to the peopling of this and other Weſt Indian iſlands, induced ſome Dutch, French, Portugueſe, and Jews, to ſettle among them with their eſtates; by which, after a certain time, they acquire the rights of naturalization in Great Britain. The white ſervants, whether by covenant or purchaſe, lead more eaſy lives than the day-labourers in England; and when they come to be overſeers, their wages and other allowances are conſiderable. As to the treatment of the negro ſlaves in this and the other iſlands, that falls to be ſpoken of under the articles NEGRO, SLAVE, WEST-INDIES; which ſee. The manners of the white inhabitants, in general, are the ſame as in moſt polite towns and countries in Europe. The capital of the iſland is called *Bridge-Town*; ſee that article.

As the hiſtory of this iſland furniſhes no very remarkable events, the following ſhort hints concerning it may ſuffice.

When

When the English, some time after the year 1625, first landed here, they found it the most savage and destitute place they had hitherto visited. It had not the least appearance of ever having been peopled even by savages. There was no kind of beasts of pasture or of prey, no fruit, no herb, no root fit for supporting the life of man. Yet as the climate was so good, and the soil appeared fertile, some gentlemen of small fortune in England resolved to become adventurers thither. The trees were so large, and of a wood so hard and stubborn, that it was with great difficulty they could clear as much ground as was necessary for their subsistence. By unremitting perseverance, however, they brought it to yield them a tolerable support; and they found that cotton and indigo agreed well with the soil; and that tobacco, which was beginning to come into repute in England, answered tolerably. These prospects, together with the storm between the king and parliament, which was beginning to break out in England, induced many new adventurers to transport themselves into this island. And what is extremely remarkable, so great was the increase of people in Barbadoes, 25 years after its first settlement, that in 1650 it contained more than 50,000 whites, and a much greater number of negro and Indian slaves. The latter they acquired by means not at all to their honour: for they seized upon all those unhappy men, without any pretence, in the neighbouring islands, and carried them into slavery; a practice which has rendered the Caribbee Indians irreconcilable to them ever since. They had begun a little before this to cultivate sugar, which soon rendered them extremely wealthy. The number of slaves, therefore, was still augmented; and in 1676 it is supposed that their number amounted to 100,000, which, together with 50,000 whites, make 150,000 on this small spot: a degree of population unknown in Holland, in China, or any other part of the world most renowned for numbers. At this time Barbadoes employed 400 sail of ships, one with another, of 150 tons in their trade. Their annual exports in sugar, indigo, ginger, cotton, and citron-water, were above L.350,000, and their circulating cash at home was L.200,000. Such was the increase of population, trade, and wealth, in the course of 50 years. But since that time this island has been much on the decline; which is to be attributed partly to the growth of the French sugar-colonies, and partly to the English establishments in the neighbouring isles. Their numbers at present are said to be 20,000 whites, and 100,000 slaves. Their commerce consists of the same articles as formerly, though they deal in them to less extent.

Barbadoes-Tar, a mineral fluid of the nature of the thicker fluid bitumens, of a nauseous bitterish taste, very strong and disagreeable smell, found in many parts of America trickling down the sides of the mountains, and sometimes floating on the surface of the waters. It has been greatly recommended in coughs, and other disorders of the breast and lungs.

BARBARA, among logicians, the first mode of the first figure of syllogisms. A syllogism in barbara is one whereof all the prepositions are universal and affirmative; the middle term being the subject of the first proposition, and attribute in the second.

Examp. Bar. Every wicked man is miserable;
Ba. All tyrants are wicked men;
Ra. Therefore all tyrants are miserable.

BARBARIAN, a name given by the ancient Greeks and Romans to all who were not of their own country, or were not initated in their language, manners, and customs.—In this sense, the word signified with them no more than foreigner; nor signifying, as among us, a wild, rude, or uncivilized person.

BARBARISM, in a general sense, a rudeness of language or behaviour.

Barbarism, in grammar, an offence against the purity of style or language; or an ungrammatical way of speaking or writing, contrary to the true idiom of any particular language.

BARBAROSSA (Aruch, and Hayradin), two famous corsairs, the sons of a potter in the isle of Lesbos, who, turning pirates, carried on their depredations with such success and conduct, that they were soon possessed of 12 galleys beside smaller vessels. Of this fleet Aruch the elder brother, called *Barbarossa* from the redness of his beard, was admiral, and Hayradin the second in command: they called themselves the *friends of the sea*, and the *enemies of all who sailed upon it*; and their names became terrible from the straits of Dardanelles to those of Gibraltar. With such a power they wanted an establishment; and the opportunity of settling themselves offered in 1516, by the inconsiderate application of Eutemi king of Algiers to them for assistance against the Spaniards. Aurch, leaving his brother to command the fleet, carried 5000 men to Algiers, where he was received as their deliverer; and secretly murdering the prince he came to aid, caused himself to be proclaimed king in his stead. To this usurpation he added the conquest of Tremecen; when his exploits and piracies induced the emperor Charles V. to furnish the Marquis de Gomarez governor of Oran with troops to suppress him; by whom he was defeated and killed near Tremecen. His brother Hayradin, known also by the name of *Barbarossa*, assumed the sceptre at Algiers with the same abilities, and with better fortune; for the Spaniards, sufficiently employed in Europe, giving him no disturbance, he regulated the interior police of his kingdom with great prudence, carried on his naval operations with vigour, and extended his conquests on the continent of Africa. He put his dominions under the protection of the Grand Signior, Solyman the Magnificent; and obtained the command of the Turkish fleet. With so powerful a protector, he acquired the kingdom of Tunis in a manner similar to that by which his brother gained Algiers. Since the time of the Barbarossas, Algiers has been understood to be dependent on the Porte; but this dependence is now little more than merely nominal.

END OF THE SECOND VOLUME.

DIRECTIONS FOR PLACING THE PLATES OF VOL. II.

[In all, 60 Plates.]